# PATENT ABSTRACTS OF JAPAN

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## (54) COMMUNICATION APPARATUS AND COMMUNICATION METHOD

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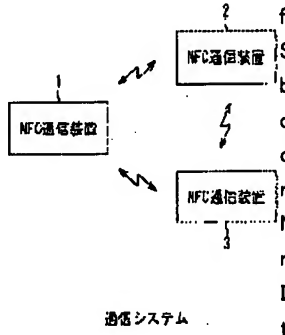


(57)Abstract:

PROBLEM TO BE SOLVED: To prevent responses from being simultaneously returned from two or more communication parties.

SOLUTION: An NFC (near field communication based on electromagnetic induction using carrier waves of a single frequency) communication apparatus 1 transmits data for requesting IDs, and acquires the IDs sent from NFC communication apparatuses 2, 3 in response to the request. After acquiring the IDs of the apparatuses 2, 3, the apparatus 1 transmits data including their IDs as the data for the apparatuses 2, 3. If the apparatus 1 cannot properly acquire the IDs of the apparatuses 2, 3, it re-transmits the data for requesting the IDs. When receiving the request for the IDs, the apparatuses 2, 3 generate their own IDs by using random numbers and transmit the generated IDs. Also, if the apparatuses 2, 3 receive the request for IDs again, the apparatuses 2, 3 re-generate the own IDs by random numbers and re-transit the generated IDs. This communication apparatus is applicable to, for example, an IC card system.

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CLAIMS

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[Claim(s)]
[Claim 1]
In the communication device which transmits and receives data by the electromagnetic wave,
An electromagnetic wave generating means to form RF (Radio Frequency) field by generating an electromagnetic wave,
A modulation means to transmit data at the transmission rate of either of two or more transmission rates by modulating an electromagnetic wave,
A recovery means to acquire the data transmitted from other equipments at the transmission rate of either of two or more transmission rates by restoring to an electromagnetic wave
Preparation,
The data which require ID (Identification) which identifies equipment besides the above are transmitted,
Said ID which equipment besides the above transmits according to the demand of said ID is acquired,
said -- others -- after acquisition of ID of equipment -- said -- others -- as the data to equipment -- said -- others -- the data containing ID of equipment -- transmitting
When ID of equipment besides the above is not able to be acquired normally, the data which require said ID are broadcast again.
The communication device characterized by things.

[Claim 2]
plurality -- said -- others -- plurality when said ID has been transmitted to coincidence from equipment -- said -- others -- when ID transmitted from equipment overlaps, the data which require said ID are broadcast again
The communication device according to claim 1 characterized by things.
[Claim 3]
In the correspondence procedure which transmits and receives data by the electromagnetic wave,
The electromagnetic wave generating step which forms RF (Radio Frequency) field by generating an electromagnetic wave,
The modulation step which transmits data at the transmission rate of either of two or more transmission rates by modulating an electromagnetic wave,
The recovery step which acquires the data transmitted from other equipments at the transmission rate of either of two or more transmission rates by restoring to an electromagnetic wave
Preparation,
The data which require ID (Identification) which identifies equipment besides the above are transmitted,
Said ID which equipment besides the above transmits according to the demand of said ID is acquired,
said -- others -- after acquisition of ID of equipment -- said -- others -- as the data to equipment -- said -- others -- the data containing ID of equipment -- transmitting
When ID of equipment besides the above is not able to be acquired normally, the data which require said ID are broadcast again.
The correspondence procedure characterized by things.
[Claim 4]
In the communication device which transmits and receives data by the electromagnetic wave,
A modulation means to transmit data at the transmission rate of either of two or more transmission rates by modulating an electromagnetic wave,
A recovery means to acquire the data transmitted from other equipments at the transmission rate of either of two or more transmission rates by restoring to an electromagnetic wave
Preparation,
When the data which require ID (Identification) which identifies self from equipment besides the above are received, a random number generates own ID and it transmits,

When the data which require ID are re-received from equipment besides the above, regeneration of own ID is carried out with a random number, and it is broadcast again, The data containing ID of said self of the data transmitted from equipment besides the above are received as data to self.
The communication device characterized by things.
[Claim 5]
By generating an electromagnetic wave, it has further an electromagnetic wave generating means to form RF (Radio Frequency) field,
Said modulation means transmits data by modulating the electromagnetic wave which said electromagnetic wave generating means outputs.
The communication device according to claim 4 characterized by things.
[Claim 6]
Said modulation means transmits data by carrying out the load modulation of the electromagnetic wave which equipment besides the above generates.
The communication device according to claim 4 characterized by things.
[Claim 7]
In the correspondence procedure which transmits and receives data by the electromagnetic wave,
The modulation step which transmits data at the transmission rate of either of two or more transmission rates by modulating an electromagnetic wave,
The recovery step which acquires the data transmitted from other equipments at the transmission rate of either of two or more transmission rates by restoring to an electromagnetic wave
Preparation,
When the data which require ID (Identification) which identifies self from equipment besides the above are received, a random number generates own ID and it transmits,
When the data which require ID are re-received from equipment besides the above, regeneration of own ID is carried out with a random number, and it is broadcast again, The data containing ID of said self of the data transmitted from equipment besides the above are received as data to self.
The correspondence procedure characterized by things.

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[Translation done.]



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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Field of the Invention]
Concerning a communication device and a correspondence procedure, in a contiguity communication link etc., this invention identifies two or more communications partners of each certainly, and relates to the communication device and correspondence procedure which enable it to prevent that a response comes to coincidence on the contrary from two or more communications partners.
[0002]
[Description of the Prior Art]
As a system which performs a contiguity communication link, IC (Integrated Curcuit) system is known widely, for example. In IC card system, when reader/writer generates an electromagnetic wave, the so-called RF (Radio Frequency) field (field) is formed. And by electromagnetic induction, if an IC card approaches reader/writer, an IC card will perform data transmission between reader/writers while receiving supply of a power source (for example, patent reference 1).
[0003]
As a specification of IC card system by which current operation is carried out, there are some which are called Type A, Type B, and Type C, for example.
[0004]
Type A is adopted as Philips's MIFARE method, encoding of the data based on Miller is carried out to the data transmission from reader/writer to an IC card, and encoding of the data based on Manchester is carried out to the data transmission from an IC card to reader/writer at it. Moreover, by Type A, 106kbps (kilo bit per second) is adopted as a transmission rate of data.

[0005]
By Type B, encoding of the data based on NRZ is carried out to the data transmission from reader/writer to an IC card, and encoding of the data twisted for the data transmission from an IC card to reader/writer NRZ-L is carried out to it. Moreover, by Type B, 106kbps is adopted as a transmission rate of data.
[0006]
Type C is adopted as a FeliCa method of Sony Corp. which is this applicant, and encoding of the data based on Manchester is carried out to the data transmission between reader/writer and an IC card. Moreover, by Type C, 212kbps is adopted as a transmission rate of data.
[0007]
[Problem(s) to be Solved by the Invention]
By the way, in IC card system, when two or more IC cards have approached to one reader/writer, reader/writer needs to identify each of two or more of the IC cards, and needs to communicate by specifying a communications partner.
[0008]
ID as a unique identification number is assigned to an IC card as an approach of identifying two or more IC cards, and there is an approach which the ID is made to report to reader/writer from an IC card.
[0009]
Thus, in assigning unique ID to an IC card, how [ IC card ] is carried out and ID does not overlap. However, memory, such as EEPROM (Electrically Erasable Programmable Read Only Memory) for always memorizing that unique ID in this case, is needed. Therefore, even when EEPROM is not required, it is necessary to prepare EEPROM in making ID memorize, and the manufacturing cost of an IC card becomes cost quantity to an IC card.
[0010]
Then, in an IC card, a random number is generated and there is the approach of using the random number temporarily as own ID. According to this approach, since it is not necessary to always memorize ID, it is not necessary to prepare EEPROM for making ID memorize.
[0011]
However, when using a random number as ID, in two or more IC cards, that the same random number is used as ID may arise. In this case, when reader/writer transmits data to that addressing to ID, and two or more IC cards answer coincidence, interference (collision) will arise and reader/writer can acquire the response from an IC card normally.
[0012]
This invention enables it to prevent that it is made in view of such a situation, identify two or more communications partners of each certainly, and a response comes to coincidence on the contrary from two or more communications partners.
[0013]
[Means for Solving the Problem]
The 1st communication device of this invention transmits the data which require ID (Identification) which identifies other equipments. ID which other equipments transmit according to the demand of ID is acquired. After acquisition of ID of other equipments As data to other equipments, when the data containing ID of other equipments are not able to be transmitted and ID of other equipments is not able to be acquired normally, it is characterized by broadcasting again the data which require ID.
[0014]
The 1st correspondence procedure of this invention transmits the data which require ID (Identification) which identifies other equipments. ID which other equipments transmit according to the demand of ID is acquired. After acquisition of ID of other equipments As data to other equipments, when the data containing ID of other equipments are not able to be transmitted and ID of other equipments is not able to be acquired normally, it is characterized by broadcasting again the data which require ID.
[0015]
When the data which require ID (Identification) which identifies self from other equipments are received, the 2nd communication device of this invention When a random number generates own ID, it transmits and the data which require ID are re-received from other equipments Regeneration of own ID is carried out with a random number, it is broadcast again, and it is characterized by receiving the data containing ID of the self of the data transmitted from other equipments as data to self.
[0016]
When the data which require ID (Identification) which identifies self from other equipments are received, the 2nd correspondence procedure of this invention When a random number generates own ID, it transmits and the data which require ID are re-received from other equipments Regeneration of own ID is carried out with a random number, it is broadcast again, and it is characterized by receiving the data containing ID of the self of the data transmitted from other equipments as data to self.
[0017]

In the 1st communication device and correspondence procedure of this invention, ID which the data which require ID (Identification) which identifies other equipments are transmitted, and other equipments transmit according to the demand of ID is acquired. And the data containing ID of other equipments are transmitted as data to other equipments after acquisition of ID of other equipments. On the other hand, when ID of other equipments is not able to be acquired normally, it retransmits a message to the data which require ID.

[0018]

In the 2nd communication device and correspondence procedure of this invention, when the data which require ID (Identification) which identifies self from other equipments are received, own ID is generated by the random number and transmitted. Moreover, when the data which require ID are re-received from other equipments, regeneration of own ID is carried out with a random number, and it retransmits a message to it. And the data containing ID of the self of the data transmitted from other equipments are received as data to self.

[0019]

[Embodiment of the Invention]

Drawing 1 shows the example of a configuration of the gestalt of 1 operation of the communication system (a system means the thing object which two or more equipments combined logically, and it does not ask whether the equipment of each configuration is in the same case) which applied this invention.

[0020]

In drawing 1 , communication system consists of three NFC communication devices 1, 2, and 3. the NFC communication device 1 thru/or 3 -- each can perform now the contiguity communication link (NFC (Near Field Communication)) by electromagnetic induction which used the subcarrier of a single frequency among other NFC communication devices.

[0021]

Here, as a frequency of the subcarrier which the NFC communication device 1 thru/or 3 use, 13.56 etc.MHz of an ISM (Industrial Scientific Medical) band etc. is employable, for example.

[0022]

Moreover, the communication link which means, and the equipments (case) which communicate contact and performs the communication link from which the distance of the equipments with which a contiguity communication link communicates is set to less than several 10cm, and becomes possible is also included.

[0023]

in addition, a thing employable as an IC card system which uses one or more [ other ] as an IC card while the communication system of drawing 1 makes reader/writer the NFC communication device 1 thru/or 1 or more [ of 3 ] -- of course -- the NFC communication device 1 thru/or 3 -- it is also possible to adopt each as communication system, such as PDA (Personal Digital Assistant), PC (Personal Computer), a cellular phone, a wrist watch, and a pen. That is, the NFC communication device 1 thru/or 3 are equipment which performs a contiguity communication link, and is not limited to an IC card, reader/writer, etc. of IC card system.

[0024]

The NFC communication device 1 thru/or 3 have two descriptions that the communication link by the two communicate modes is possible to the 1st, and that the data transmission by two or more transmission rates is possible to the 2nd.

[0025]

There are the passive mode and the active mode as the two communicate modes. When it takes notice of the communication link between the NFC communication device 1 thru/or the NFC communication devices 1 and 2 of 3 now, in the passive mode The NFC communication device 1 which is one NFC communication device of the NFC communication devices 1 and 2 like the conventional IC card system mentioned above Data are transmitted to the NFC communication device 2 which is a NFC communication device of another side by modulating the electromagnetic wave (corresponding subcarrier) which self generates. The NFC communication device 2 By carrying out the load modulation of the electromagnetic wave (corresponding subcarrier) which the NFC communication device 1 generates, data are transmitted to the NFC communication device 1.

[0026]

On the other hand, in the active mode, all of the NFC communication devices 1 and 2 transmit data by modulating the electromagnetic wave (corresponding subcarrier) which self generates.

[0027]

When performing the contiguity communication link by electromagnetic induction here, an electromagnetic wave is outputted first, a communication link is started, and the equipment which has the communicative leadership so to speak is called an initiator. An initiator transmits a command to a communications partner, and although the communications partner is the form where the response to the command is returned and a contiguity communication link is performed, it calls a target the communications

partner which returns the response to the command from an initiator.

[0028]

For example, supposing the NFC communication device 1 starts the output of an electromagnetic wave and starts the communication link with the NFC communication device 2 now, as shown in drawing 2 and drawing 3 , the NFC communication device 1 will serve as an initiator, and the NFC communication device 2 will serve as a target.

[0029]

And the NFC communication device 1 which is an initiator as shown in drawing 2 in the passive mode outputs an electromagnetic wave continuously, and while the NFC communication device 1 transmits data to the NFC communication device 2 which is a target by modulating the electromagnetic wave which self is outputting, the NFC communication device 2 transmits data to the NFC communication device 1 by carrying out the load modulation of the electromagnetic wave which the NFC communication device 1 which is an initiator is outputting.

[0030]

On the other hand, in the active mode, as shown in drawing 3 , the NFC communication device 1 which is an initiator transmits data to the NFC communication device 2 which is a target by starting the output of an electromagnetic wave in person and modulating the electromagnetic wave, when self transmits data. And the NFC communication device 1 suspends the output of an electromagnetic wave after transmitting termination of data. When self transmits data, and the NFC communication device 2 which is a target also starts the output of an electromagnetic wave in person and modulates the electromagnetic wave, data are transmitted to the NFC communication device 1 which is an initiator. And the NFC communication device 2 suspends the output of an electromagnetic wave after transmitting termination of data.

[0031]

In addition, the NFC communication device 1 thru/or 3 mention later about the 2nd focus that the data transmission by two or more transmission rates is possible.

[0032]

Moreover, although communication system is constituted from drawing 1 by three NFC communication devices 1 thru/or 3, the NFC communication device which constitutes communication system may not be limited to three, and may be 2 or 4 or more. Furthermore, communication system can also be constituted including an IC card, reader/writer, etc. which constitute other, for example, the conventional IC, card systems [ communication device / NFC ].

[0033]

Next, drawing 4 shows the example of a configuration of the NFC communication device 1 of drawing 1 . In addition, since other NFC communication devices 2 and 3 of drawing 1 as well as the NFC communication device 1 of drawing 4 are constituted, the explanation is omitted.

[0034]

The antenna 11 constitutes the coil of a closed loop, is that the current which flows in this coil changes, and outputs an electromagnetic wave. Moreover, a current flows at an antenna 11 because the magnetic flux which passes along the coil as an antenna 11 changes.

[0035]

A receive section 12 receives the current which flows at an antenna 11, performs alignment and detection, and outputs to the recovery section 13. The recovery section 13 restores to the signal supplied from a receive section 12, and supplies it to the decoding section 14. The decoding section 14 decodes the Manchester code as a signal supplied from the recovery section 13 etc., and supplies the data obtained as a result of the decoding to the data-processing section 15.

[0036]

The data-processing section 15 performs processing which should be performed with protocols, such as the transport layer, and other predetermined processings based on the data supplied from the decoding section 14. Moreover, the data-processing section 15 supplies the data which should be transmitted to other equipments to the encoding section 16. Furthermore, the data-processing section 15 receives the random number supplied from the random-number-generation section 24, and generates NFCID (NFC Identification) as information which specifies the NFC communication device itself from the random number. NFCID generated from the random number supplied from the random-number-generation section 24 is arranged to the polling response frame mentioned later as NFCID which specifies self, and the data-processing section 15 supplies it to the encoding section 16, when NFCID is required by the polling request frame mentioned later from other equipments.

[0037]

The encoding section 16 encodes the data supplied from the data-processing section 15 to a Manchester code etc., and supplies them to the selection section 17. The selection section 17 chooses either the modulation section 19 or the load modulation sections 20, and outputs the signal supplied to the selected one of it from the encoding section 16.

[0038]
Here, the selection section 17 chooses the modulation section 19 or the load modulation section 20 according to control of a control section 21. The communicate mode is the passive mode, and a control section 21 makes the load modulation section 20 choose it as the selection section 17, when the NFC communication device 1 serves as a target. Moreover, a control section 21 makes the modulation section 19 choose it as the selection section 17, when the communicate mode is the active mode, or when the communicate mode is the passive mode and the NFC communication device 1 serves as an initiator. Therefore, although the communicate mode is the passive mode and the signal which the encoding section 16 outputs is supplied to the load modulation section 20 through the selection section 17 in the case where the NFC communication device 1 serves as a target, it is supplied to the modulation section 19 through the selection section 17 in other cases.
[0039]
The electromagnetic wave output section 18 passes the current for making the subcarrier (electromagnetic wave) of a single predetermined frequency emit from an antenna 11 at an antenna 11. The electromagnetic wave output section 18 modulates the modulation section 19 according to the signal to which the subcarrier as a current passed at an antenna 11 is supplied from the selection section 17. Thereby, from an antenna 11, the electromagnetic wave on which the data-processing section 15 modulated the subcarrier according to the data outputted to the encoding section 16 is emitted.
[0040]
The load modulation section 20 changes the impedance when seeing the coil as an antenna 11 from the exterior according to the signal supplied from the selection section 17, and, thereby, performs a load modulation. When other equipments output the electromagnetic wave as a subcarrier, RF field (field) is formed in the perimeter of an antenna 11, and the impedance when seeing the coil as an antenna 11 changes, RF field around an antenna 11 also changes. The subcarrier as an electromagnetic wave which other equipments are outputting is modulated by this according to the signal supplied from the selection section 17, and the data which the data-processing section 15 outputted to the encoding section 16 are transmitted to other equipments which are outputting the electromagnetic wave.
[0041]
Here, as a modulation technique in the modulation section 19 and the load modulation section 20, amplitude modulation (ASK (Amplitude Shift Keying)) is employable, for example. However, it is not limited to ASK and the modulation technique in the modulation section 19 and the load modulation section 20 can adopt PSK (Phase Shift Keying), and QAM (Quadrature Amplitude Modulation) and others. Moreover, what is necessary is not to be limited to numeric values, such as 8% to 30%, 50%, and 100 etc.%, about the modulation factor of the amplitude, and just to choose a suitable thing.
[0042]
A control section 21 controls each block which constitutes the NFC communication device 1. A power supply section 22 supplies a power source required for each block which constitutes the NFC communication device 1. In addition, since drawing becomes complicated, the illustration showing controlling each block whose control section 21 constitutes the NFC communication device 1 by drawing 4 of a line, and illustration of the line by which a power supply section 22 means supplying a power source in each block which constitutes the NFC communication device 1 have been omitted.
[0043]
A detecting element 23 detects whether the current which flows at an antenna 11 is received like a receive section 12, and the electromagnetic wave more than predetermined level (flux density) is received by the antenna 11 based on the current.
[0044]
The random-number-generation section 24 generates a random number, and supplies it to the data-processing section 15.
[0045]
In the above-mentioned case, in the decoding section 14 and the encoding section 16, the Manchester code adopted by the above-mentioned type C was processed here, but in the decoding section 14 and the encoding section 16, process is able to choose one from two or more kinds of signs, such as not only a Manchester code but modification DOMIRA adopted by Type A, NRZ adopted by Type C, and to make it.
[0046]
Next, drawing 5 shows the example of a configuration of the recovery section 13 of drawing 4 .
[0047]
At drawing 5 , the recovery section 13 consists of the recovery section 321 of N individual which are the 31 or 2 or more selection sections thru/or 32 Ns, and the selection section 33.
[0048]
According to control of a control section 21 ( drawing 4 ), while being the recovery

section 321 of N individual thru/or 32Ns, from from, the selection section 31 chooses 32n (n= 1, 2, ..., N) of one recovery section, and supplies the signal which a receive section 12 outputs to 32n of the selected recovery section.

[0049]

32n of recovery sections restores to the signal transmitted at the n-th transmission rate, and they supply it to the selection section 33. Here, 32n of recovery sections and 32n [ of recovery sections ]' (n!=n') restore to the signal transmitted at a different transmission rate. Therefore, the recovery section 13 of drawing 5 can restore now to the signal transmitted at the transmission rate as N of the 1st thru/or ** a Nth. in addition, as a transmission rate as N, it mentioned above, for example -- high-speed 424kbps(es), 848kbps, etc. can be adopted further more 212 kbps 106 kbpses. That is, the transmission rate already adopted in the contiguity communication link of the existing IC card system etc. and the other transmission rate can be included in the transmission rate as N.

[0050]

According to control of a control section 21, while being the recovery section 321 of N individual thru/or 32Ns, from from, the selection section 33 chooses 32n of one recovery section, and supplies the recovery output obtained in 32n of the recovery section to the decoding section 14.

[0051]

A control section 21 ( drawing 4 ) makes the selection section 31 make sequential selection of the recovery section 321 of N individual thru/or the 32 Ns, and, thereby, makes it recover the recovery section 321 thru/or 32Ns of signals supplied through the selection section 31 from a receive section 12 to each in the recovery section 13 constituted as mentioned above. And a control section 21 recognizes 32n of recovery sections which were able to recover normally the signal supplied through the selection section 31 from the receive section 12, and controls the selection section 33 to choose the output of 32n of the recovery section. The selection section 33 chooses 32n of recovery sections according to control of a control section 21, and, thereby, the normal recovery output obtained in 32n of recovery sections is supplied to the decoding section 14.

[0052]

Therefore, in the recovery section 13, it can restore to the signal transmitted at the transmission rate of the arbitration of the transmission rates as N.

[0053]

In addition, only when it is able to get over normally, a recovery output is outputted, nothing is outputted, it can twist (for example, it becomes high impedance), and the recovery section 321 thru/or 32 Ns can be made like, when it is not able to get over normally. In this case, the selection section 33 takes the recovery section 321 thru/or an OR with an outputs [ all ] of 32 Ns, and should just output it to the decoding section 14.

[0054]

Next, drawing 6 shows the example of a configuration of the modulation section 19 of drawing 4 .

[0055]

At drawing 6 , the modulation section 19 consists of the modulation section 421 of N individual which are the 41 or 2 or more selection sections thru/or 42 Ns, and the selection section 43.

[0056]

According to control of a control section 21 ( drawing 4 ), while being the modulation section 421 of N individual thru/or 42Ns, from from, the selection section 41 chooses 42n (n= 1, 2, ..., N) of one modulation section, and supplies the signal which the selection section 17 ( drawing 4 ) outputs to 42n of the selected modulation section.

[0057]

42n of modulation sections is modulated through the selection section 43 according to the signal to which the subcarrier as a current which flows at an antenna 11 is supplied from the selection section 41 so that transmission of data may be performed at the n-th transmission rate. Here, 42n of modulation sections and 42n [ of modulation sections ]' (n!=n') modulate a subcarrier at a different transmission rate. Therefore, the modulation section 19 of drawing 6 can transmit data now at the transmission rate as N of the 1st thru/or ** a Nth. In addition, as a transmission rate as N, the same transmission rate as the ability to restore to the recovery section 13 of drawing 5 is employable, for example.

[0058]

According to control of a control section 21, while being the modulation section 421 of N individual thru/or 42Ns, from from, the selection section 43 chooses the 42n of the same modulation sections as the selection section 41 choosing, and connects electrically 42n of the modulation section, and an antenna 11.

[0059]

A control section 21 ( drawing 4 ) makes the selection section 41 make sequential selection of the modulation section 421 of N individual thru/or the 42 Ns, and, thereby, makes it modulate 42Ns of subcarriers as a current which flow at an antenna 11

through the selection section 43 in the modulation section 19 constituted as mentioned above according to the modulation section 421 thru/or the signal supplied to each from the selection section 41.

[0060]

Therefore, in the modulation section 19, a subcarrier can be modulated and data can be transmitted so that data may be transmitted at the transmission rate of the arbitration of the transmission rates as N.

[0061]

In addition, since it is constituted like the modulation section 19 of drawing 6, the load modulation section 20 of drawing 4 omits the explanation.

[0062]

As mentioned above, in the NFC communication device 1 thru/or 3, while modulating a subcarrier to the signal of the data to which it is transmitted at the transmission rate of either of the transmission rates as N, it can restore to the signal of the data transmitted at the transmission rate of either of the transmission rates as N. And as mentioned above, the transmission rate already adopted in the contiguity communication link of the existing IC card systems (FeliCa method etc.) etc. and the other transmission rate can be included in the transmission rate as N, for example. Therefore, according to the NFC communication device 1 thru/or 3, between each, data can be exchanged at any transmission rate of the transmission rate as the N. Furthermore, according to the NFC communication device 1 thru/or 3, data can be exchanged at the transmission rate which the IC card and reader/writer have adopted also between the IC cards and reader/writers which constitute the existing IC card system.

[0063]

And even if it, as a result, introduces the NFC communication device 1 thru/or 3 into the service as which the existing contiguity communication link is adopted, a user cannot do derangement etc., therefore the installation can be performed easily. Furthermore, the NFC communication device 1 thru/or 3 can be easily introduced also into the service as which the contiguity communication link by the high-speed data rate it is expected to be to appear in the future is adopted, aiming at coexistence with the existing contiguity communication link.

[0064]

Moreover, in the NFC communication device 1 thru/or 3, since the data transmission in the active mode in which data are transmitted when self besides the passive mode adopted by the conventional contiguity communication link outputs an electromagnetic wave is possible, even if it does not mind other equipments, such as reader/writer, data can be exchanged directly.

[0065]

Next, drawing 7 shows other examples of a configuration of the recovery section 13 of drawing 4. In addition, about the case in drawing 5, and the corresponding part, the same sign is attached among drawing, and, below, the explanation is omitted suitably. That is, the recovery section 13 of drawing 7 is fundamentally constituted similarly with the case [ the selection section 31 is not formed and also ] in drawing 5.

[0066]

That is, to the recovery section 321 thru/or 32 Ns, the signal which a receive section 12 outputs with the gestalt of operation of drawing 7 is supplied to coincidence, and the signal from a receive section 12 restores to it by the recovery section 321 thru/or 32Ns at coincidence. And a control section 21 recognizes 32n of recovery sections which were able to restore to the signal from a receive section 12 normally, and controls the selection section 33 to output 32n of the recovery section. The selection section 33 chooses 32n of recovery sections according to control of a control section 21, and, thereby, the normal recovery output obtained in 32n of recovery sections is supplied to the decoding section 14.

[0067]

In addition, it is necessary to make recovery actuation always perform to the recovery section 321 thru/or 32 Ns with the gestalt of operation of drawing 7. On the other hand, with the gestalt of operation of drawing 5, recovery actuation can be made to be able to perform only to what is chosen as the selection section 31 the recovery section 321 thru/or of the 32 Ns, and other things can stop actuation. Therefore, from a viewpoint which saves the power consumption of equipment, the configuration of drawing 5 is more advantageous than drawing 7. From a viewpoint which obtains a normal recovery output at an early stage on the other hand, the configuration of drawing 7 is more advantageous than drawing 5.

[0068]

Next, drawing 8 shows the example of a configuration of further others of the recovery section 13 of drawing 4.

[0069]

At drawing 8, the recovery section 13 consists of the adjustable rate recovery section 51 and a rate detecting element 52.

[0070]

The adjustable rate recovery section 51 restores to the signal supplied from a receive

section 12 as a signal of the transmission rate according to the directions from the rate detecting element 52, and supplies the recovery result to the decoding section 14. The rate detecting element 52 detects the transmission rate of the signal supplied from a receive section 12, and it directs it in the adjustable rate recovery section 51 so that it may restore to the signal of the transmission rate.

[0071]

In the recovery section 51 constituted as mentioned above, the signal which a receive section 12 outputs is supplied to the adjustable rate recovery section 51 and the rate detecting element 52. The rate detecting element 52 is directed in the adjustable rate recovery section 51 so that the transmission rate of the signal supplied from a receive section 12 may detect any of the transmission rates as N of the 1st thru/or ** a Nth they are and may restore to the signal of the transmission rate. And the adjustable rate recovery section 51 restores to the signal supplied from a receive section 12 as a signal of the transmission rate according to the directions from the rate detecting element 52, and supplies the recovery result to the decoding section 14.

[0072]

Next, each of NFC communication device 1 thru/or 3 can become the initiator which outputs an electromagnetic wave first and starts a communication link. Furthermore, in the active mode, the NFC communication device 1 thru/or 3 output an electromagnetic wave in person, when becoming an initiator, or when becoming a target.

[0073]

When two or more [ of them ] output an electromagnetic wave to coincidence, it becomes impossible therefore, to communicate by collision (collision) arising in the condition that the NFC communication device 1 thru/or 3 are close.

[0074]

the NFC communication device 1 thru/or 3 -- only when it does not detect and exist [ whether the electromagnetic wave (RF field to depend) from other equipments exists, and ], each starts the output of an electromagnetic wave and, thereby, prevents collision. [ then, ] Here, in this way, only when it does not detect and exist [ whether the electromagnetic wave from other equipments exists, and ], the processing which starts the output of an electromagnetic wave is called RFCA (RF Collision Avoidance) processing from the purpose of preventing collision.

[0075]

There are two, the initial RFCA processing which the NFC communication device (the NFC communication device 1 thru/or 1 or more [ Drawing 1 / of 3 ]) which is going to serve as an initiator performs first, and the response RFCA processing performed whenever the NFC communication device which starts the output of an electromagnetic wave during a communication link with the active mode tends to carry out the initiation, in RFCA processing. Only when it does not detect and exist [ whether the electromagnetic wave by other equipments exists, and ] before starting the output of an electromagnetic wave even if it is initial RFCA processing and is response RFCA processing, the point of starting the output of an electromagnetic wave is the same. However, by initial RFCA processing and response RFCA processing, since existence of the electromagnetic wave by other equipments is no longer detected, the time amount to the timing which must start the output of an electromagnetic wave etc. differs.

[0076]

Then, with reference to drawing 9 , initial RFCA processing is explained first.

[0077]

Drawing 9 shows the electromagnetic wave by which an output is started by initial RFCA processing. In addition, in drawing 9 (the same is said of drawing 10 mentioned later), an axis of abscissa expresses time amount and an axis of ordinate expresses the level of the electromagnetic wave which a NFC communication device outputs.

[0078]

The NFC communication device which is going to serve as an initiator is detecting the electromagnetic wave by other equipments, and after only the output to the time amount TIRFG passes [ the electromagnetic wave by other equipments ] by starting the output of an electromagnetic wave when only time amount TIDT+nxTRFW is not detected continuously, it always starts transmission (Send Request) of data (a command is included).

[0079]

Here, TIDT in time amount TIDT+nxTRFW is called initial delay time amount, and if it is expressing the frequency of a subcarrier with fc, an adult value will be adopted from 4096/fc, for example. n is or more 0 three or less integer, and is generated using a random number. TRFW is called RF latency time, for example, 512/fc is adopted. Time amount TIRFG is called an initial guard time, for example, an adult value is adopted from 5ms.

[0080]

In addition, reduction of possibility of starting the output of an electromagnetic wave is achieved to the timing that two or more NFC communication devices are the same, by adopting n which is a random number as time amount TIDT+nxTRFW by which an

electromagnetic wave must not be detected.

[0081]

When a NFC communication device starts the output of an electromagnetic wave by initial RFCA processing, the NFC communication device serves as an initiator, but when the active mode is set up as the communicate mode at that time, the NFC communication device used as an initiator suspends the output of an electromagnetic wave, after ending transmission of own data. On the other hand, as the communicate mode, when the passive mode is set up, the NFC communication device used as an initiator continues the output of the electromagnetic wave started by initial RFCA processing as it is until the communication link with a target is completed completely.

[0082]

Next, drawing 10 shows the electromagnetic wave by which an output is started by response RFCA processing.

[0083]

The NFC communication device which is going to output an electromagnetic wave in the active mode detects the electromagnetic wave by other equipments, and after only the output to the time amount TARFG passes [ the electromagnetic wave by other equipments ] by starting the output of an electromagnetic wave when only time amount TADT+nxTRFW is not detected continuously, it starts transmission (Send Responsese) of data.

[0084]

Here, n and TRFW in time amount TADT+nxTRFW are the same as that of the case in initial RFCA processing of drawing 9 . Moreover, TADT in time amount TADT+nxTRFW is called an active delay time, for example, the value below 2559-/fc is adopted more than 768-/fc. Time amount TARFG is called an active guard time, for example, an adult value is adopted from 1024/fc.

[0085]

In order to start the output of an electromagnetic wave by initial RFCA processing so that clearly from drawing 9 and drawing 10 , an electromagnetic wave must not exist between the initial delay time amount TIDT at least, and in order to start the output of an electromagnetic wave by response RFCA processing, an electromagnetic wave must not exist between the active delay times TADT at least.

[0086]

And the condition that an electromagnetic wave does not exist rather than the case where it is going to output an electromagnetic wave during a communication link with the active mode from the initial delay time amount4096/fc when a NFC communication device tends to become an initiator, since the active delay time TADT is a value below 2559-/fc more than 768-/fc to TIDT being an adult value is the long duration need. Conversely, if it says, when a NFC communication device tends to output an electromagnetic wave during a communication link with the active mode, after being in the condition that an electromagnetic wave does not exist from the case where it is going to become an initiator, an electromagnetic wave must be outputted so much for between to a dish. This is based on the following reasons.

[0087]

That is, when NFC communication devices communicate in the active mode, one NFC communication device outputs an electromagnetic wave in person, transmits data, and suspends the output of an electromagnetic wave after that. And the NFC communication device of another side starts the output of an electromagnetic wave, and data are transmitted. Therefore, in the communication link in the active mode, any NFC communication device may have suspended the output of an electromagnetic wave. for this reason, when a NFC communication device tends to become an initiator, in order to check that the communication link in the active mode is not performed around that NFC communication device, the perimeter of the NFC communication device which is going to become an initiator is enough in other equipments not outputting the electromagnetic wave -- it is necessary to carry out a time amount check

[0088]

On the other hand, in the active mode, as mentioned above, when an initiator outputs an electromagnetic wave, data are transmitted to a target. And a target transmits data to an initiator by starting the output of an electromagnetic wave, after an initiator suspends the output of an electromagnetic wave. Then, after, as for an initiator, a target suspends the output of an electromagnetic wave, by starting the output of an electromagnetic wave, data are transmitted to an initiator and data are hereafter exchanged between an initiator and a target similarly.

[0089]

Therefore, around the initiator which is communicating the active mode, and a target When the NFC communication device which is going to serve as an initiator exists, after one side of the initiators and targets which are communicating the active mode suspends the output of an electromagnetic wave If time amount until another side starts the output of an electromagnetic wave is long, since an electromagnetic wave does not exist in the meantime, the NFC communication device which is going to serve as an initiator starts the output of an electromagnetic wave by initial RFCA

processing. In this case, the communication link in the active mode currently performed previously will be barred.

[0090]

For this reason, after being in the condition that an electromagnetic wave does not exist, he is trying to have to output an electromagnetic wave for between to a dish so much in the response RFCA processing performed during the communication link in the active mode.

[0091]

Next, as drawing 9 explained, by initial RFCA processing, the NFC communication device which is going to become an initiator starts the output of an electromagnetic wave, and performs transmission of data after that. Although the NFC communication device which is going to become an initiator is starting the output of an electromagnetic wave, and serves as an initiator and the NFC communication device which exists in the location close to the initiator serves as a target, an initiator must specify the target which exchanges the data, in order to carry out an exchange of a target and data. For this reason, an initiator requires NFCID as information which specifies each target from one or more targets which exist in the location close to that initiator, after starting the output of an electromagnetic wave by initial RFCA processing. And the target which exists in the location close to an initiator transmits NFCID which specifies self to an initiator according to the demand from an initiator.

[0092]

Although an initiator specifies a target and exchanges data between the specified target by NFCID transmitted from a target as mentioned above, the processing whose initiator specifies the target which exists in the perimeter (approaching location) by the NFCID is called SDD (Single Device Detection) processing.

[0093]

Here, in SDD processing, although an initiator requires NFCID of a target, this demand is performed, when an initiator transmits the frame called a polling request frame. If a polling request frame is received, a target will determine own NFCID with a random number, and will transmit the frame called the polling response frame which has arranged the NFCID, for example. An initiator is receiving the polling response frame transmitted from a target, and recognizes NFCID of a target.

[0094]

By the way, when an initiator requires the NFCID from the target of the perimeter and two or more targets exist in the perimeter of an initiator, NFCID may be transmitted to 2, as mentioned above coincidence of two or more of the targets. In this case, NFCID transmitted from those two or more targets cannot carry out collision, and an initiator cannot recognize that NFCID that carried out collision.

[0095]

Then, SDD processing is performed by the approach using a time slot in order to avoid the collision of NFCID if possible.

[0096]

That is, drawing 11 shows the sequence of the SDD processing performed by the approach which used the time slot. In addition, in drawing 11 , five target #1, #2, #3, #4, and #5 shall have existed in the perimeter of an initiator.

[0097]

In SDD processing, although an initiator transmits a polling request frame, only the predetermined time amount Td is set after completion of the transmission, and the time slot of the width of face of the predetermined time amount Ts is prepared. In addition, time amount Td is set to 512x64/fc, and time amount Ts as width of face of a time slot is set to 256x64/fc. Moreover, a time slot is specified by giving the sequential number (integer) from [ from what is preceded most ] 0 to for example, a time amount target.

[0098]

Although four, time-slot #0, #1, #2, and #3, are shown, a time slot can be prepared to predetermined numbers, such as 16, here at drawing 11 . An initiator specifies the number TSN of the time slots prepared to a certain polling request frame, it is included in a polling request frame, and is transmitted to a target.

[0099]

A target receives the polling request frame transmitted from an initiator, and recognizes the number TSN of the time slots arranged at the polling request frame. Furthermore, a target generates the integer R of the range of more than 0TSN-1 with a random number, is the timing of time-slot #R specified for the integer R, and transmits the polling response frame which has arranged own NFCID.

[0100]

As mentioned above, since a target determines the time slot as timing which transmits a polling response frame with a random number, the timing to which two or more targets transmit a polling response frame will vary, and, thereby, it can avoid the collision of the polling response frames which two or more targets transmit as much as possible.

[0101]

In addition, in a target, even if a random number determines the time slot as timing

which transmits a polling response frame, the time slot to which two or more targets transmit a polling response frame may be in agreement, and, thereby, the collision of a polling response frame may arise. In time-slot #0, in time-slot #1, the polling response frame of target #2 is transmitted [ in / in the polling response frame of target #1 and #3 / time-slot #3 ] for the polling response frame of target #5, respectively, and the polling response frame of target #1 and #3 has produced [ in / in the polling response frame of target #4 / time-slot #2 ] collision with the gestalt of operation of drawing 11.

[0102]

In this case, an initiator cannot receive normally the polling response frame of target #1 and #3 which has produced collision. Therefore, again, an initiator transmits a polling request frame and, thereby, requires transmission of the polling response frame by which each NFCID has been arranged from target #1 and #3. target #1 which is in the perimeter in an initiator hereafter thru/or #5 — transmission of the polling request frame by the initiator and transmission of the polling response frame by the target are repeatedly performed until it can recognize all NFCID(s).

[0103]

In addition, when an initiator transmits a polling request frame again, and when [ all target #1 thru/or #5 ] a polling response frame is returned, possibility that polling response frames will start collision is size again. Then, in a target, when a polling request frame is again received so much for time amount as a dish after receiving a polling request frame from an initiator, the polling request can be disregarded, for example. However, since an initiator cannot recognize that NFCID of target #1 and #3 about target #1 which has produced the collision of a polling response to the polling request frame transmitted first with the gestalt of operation of drawing 11 in this case, and #3, an exchange of the data between target #1 or #3 can be performed.

[0104]

Then, a polling response frame is received normally, and an initiator removes temporarily from the candidate for a communication link, and can be prevented from returning the polling response frame as a response to a polling request frame by this about target #2 which have recognized the NFCID, #4, and #5, so that it may mention later. In this case, returning a polling response frame is set only to target #1 which has not recognized NFCID by transmission of the first polling request frame, and #3 to the polling request frame for the second time which an initiator transmits. therefore -- while making small possibility that polling response frames will start collision in this case -- target #1 thru/or #5 — it becomes possible to recognize all NFCID(s).

[0105]

Moreover, a target will determine own NFCID with a random number here, if a polling request frame is received as mentioned above (generation). For this reason, from a different target, the same NFCID is arranged at a polling response frame, and may be transmitted to an initiator. When the polling response frame by which the same NFCID has been arranged is received, a polling request frame can be made to transmit to an initiator again like the case where for example, polling response frames start collision, in the time slot from which an initiator differs.

[0106]

In addition, in the above-mentioned case, an initiator prepares a time slot on the basis of the timing immediately after transmitting a polling request frame, it is the timing of the time slot, and the target transmitted the polling response frame, but the exchange of the polling request frame between an initiator and a target and a polling response frame can be carried out, without using a time slot. That is, when a polling request frame is received, a target is the timing of arbitration and can transmit a polling response frame. However, it is expected that the case where two or more targets transmit a polling response frame to a coincidence term increases to the polling request frame which an initiator transmits as compared with the case where a time slot is used in this case. And when two or more targets transmit a polling response frame to a coincidence term, since an initiator cannot carry out normal reception of the polling response frame by collision, it needs to broadcast a polling request frame again.

[0107]

Here, as mentioned above, also between the IC cards and reader/writers which constitute the existing IC card system, a NFC communication device is the transmission rate which the IC card and reader/writer have adopted, and can exchange data. Now, when a target is the IC card of the existing IC card system, SDD processing is performed as follows, for example.

[0108]

That is, the IC card an initiator starts the output of an electromagnetic wave by initial RFCA processing, and is [ IC card ] a target acquires a power source from the electromagnetic wave, and starts processing. That is, since a target is the IC card of the existing IC card system in now, the power source for operating is generated from the electromagnetic wave which an initiator outputs.

[0109]

After a target acquires a power source and is in the condition that it can operate, the

preparations with which the longest also receives a polling request frame within 2 seconds are made, and it waits to transmit a polling request frame from an initiator, for example.

[0110]

On the other hand, an initiator can transmit a polling request frame regardless of whether the preparation which receives a polling request frame in a target was completed.

[0111]

When the polling request frame from an initiator is received, as mentioned above, a target is the timing of a predetermined time slot and transmits a polling response frame to an initiator. When normal reception of the polling response frame from a target is able to be carried out, an initiator recognizes NFCID of the target, as mentioned above. On the other hand, an initiator can transmit a polling request frame again, when normal reception of the polling response frame from a target is not able to be carried out.

[0112]

In addition, since a target is the IC card of the existing IC card system in now, the power source for operating is generated from the electromagnetic wave which an initiator outputs. For this reason, an initiator continues until the communication link with a target ends completely the output of the electromagnetic wave started by initial RFCA processing.

[0113]

Next, a communication link is performed by the NFC communication device by what (it returns) an initiator transmits a command to a target and a target transmits the response to the command from an initiator for.

[0114]

Then, drawing 12 shows the command which an initiator transmits to a target, and the response which a target transmits to an initiator.

[0115]

In drawing 12 , that the alphabetic character of REQ is described to be after the underbar () expresses a command, and that the alphabetic character of RES is described to be after the underbar () expresses a response. With the gestalt of operation of drawing 12 , as a command, six kinds, ATR_REQ, WUP_REQ, PSL_REQ, DEP_REQ, DSL_REQ, and RLS_REQ, are prepared, and six kinds, ATR_RES, WUP_RES, PSL_RES, DEP_RES, DSL_RES, and RLS_RES, are prepared like the command also as a response to a command. Since an initiator transmits a command (request) to a target and a target transmits the response corresponding to the command to an initiator as mentioned above, a command is transmitted by the initiator and a response is transmitted with a target.

[0116]

Command ATR_REQ is transmitted to a target, when requiring the attribute of a target, while an initiator tells an own attribute (specification) to a target. Here, as an attribute of an initiator or a target, there is a transmission rate of the data which can transmit and receive the initiator or target etc. In addition, to command ATR_REQ, NFCID which specifies its initiator besides the attribute of an initiator is arranged, and a target recognizes the attribute and NFCID of an initiator by receiving command ATR_REQ.

[0117]

Response ATR_REQ is transmitted to an initiator as a response to the command ATR_REQ, when a target receives command ATR_REQ. An attribute, NFCID, etc. of a target are arranged at response ATR_REQ.

[0118]

In addition, all the transmission rates of the data which can transmit and receive an initiator and a target can be included in the information on the transmission rate as an attribute arranged at command ATR_REQ or response ATR_REQ. In this case, between an initiator and a target, only by the exchange of command ATR_REQ and response ATR_REQ being performed once, the transmission rate which can transmit and receive a target can be recognized and, as for an initiator, a target can also recognize the transmission rate which can transmit and receive an initiator.

[0119]

Command WUP_REQ is transmitted when an initiator chooses the target which communicates. That is, although a target can be made into a DISEREKUTO (deselect) condition (condition which forbade transmission (response) of the data to an initiator) by transmitting command DSL_REQ mentioned later to a target from an initiator, command WUP_REQ dispels the DISEREKUTO condition, and when making a target into the condition of enabling transmission of the data to an initiator, it is transmitted. In addition, the target specified as command WUP_REQ by NFCID which NFCID of a target which dispels a DISEREKUTO condition is arranged and is arranged at the command WUP_REQ among the targets which received command WUP_REQ dispels a DISEREKUTO condition.

[0120]

Response WUP_RES is transmitted as a response to command WUP_REQ, when the

target specified by NFCID arranged at the command WUP_REQ among the targets which received command WUP_REQ dispels a DISEREKUTO condition.

[0121]

Command PSL_REQ is transmitted when an initiator changes the communications parameter about the communication link with a target. Here, as a communications parameter, there is a transmission rate of the data exchanged between an initiator and a target etc., for example.

[0122]

The value of the communications parameter after modification is arranged at command PSL_REQ, and it is transmitted to a target from an initiator. A target receives command PSL_REQ and changes a communications parameter according to the value of the communications parameter arranged there. Furthermore, a target transmits response PSL_RES to command PSL_REQ.

[0123]

The data which command DEP_REQ is transmitted when an initiator transmits and receives data (the so-called live data) (data exchange between targets), and should be transmitted to a target there are arranged. The data which a target should transmit response DEP_RES as a response to command DEP_REQ, and should be transmitted there at an initiator are arranged. Therefore, data are transmitted to a target by command DEP_REQ from an initiator, and data are transmitted to an initiator from a target by response DEP_RES to the command DEP_REQ.

[0124]

Command DSL_REQ is transmitted when an initiator makes a target a DISEREKUTO condition. The target which received command DSL_REQ will transmit response DSL_RES to the command DSL_REQ, will be in a DISEREKUTO condition, and will not react to any commands other than command WUP_REQ henceforth (it stops returning a response).

[0125]

Command RLS_REQ is transmitted when an initiator ends the communication link with a target completely. The target which received command RLS_REQ transmits response RLS_RES to the command RLS_REQ, and ends the communication link with an initiator completely.

[0126]

Here, each of command DSL_REQ and RLS_REQ is common in that a target is released from the object of the communication link with an initiator. However, although the target released by command DSL_REQ will be in an initiator and the condition which can be communicated again by command WUP_REQ, the target released by command RLS_REQ will not be in an initiator and the condition which can be communicated, unless the exchange of the polling request frame mentioned above and a polling response frame is performed between initiators. At this point, command DSL_REQ differs from RLS_REQ.

[0127]

In addition, when transmitting a command to a certain target, an initiator includes in a command NFCID of the target recognized by exchanging a polling request frame and a polling response frame between targets, and transmits. On the other hand, a target transmits the response to the command to an initiator, when a command is received and NFCID contained in the command is in agreement with own NFCID.

[0128]

Moreover, the exchange of a command and a response can be performed by the transport layer.

[0129]

Next, the communications processing of a NFC communication device is explained with reference to the flow chart of drawing 13 .

[0130]

A NFC communication device judges first whether the electromagnetic wave by other equipments was detected in step S1, when starting a communication link.

[0131]

Here, in a NFC communication device ( drawing 4 ), for example, the control section 21 is supervising the level of the electromagnetic wave (the electromagnetic wave used with a NFC communication device, and electromagnetic wave with the same frequency band etc.) detected by the detecting element 23, and it is judged at step S1 based on the level whether the electromagnetic wave by other equipments was detected.

[0132]

In step S1, when judged with the electromagnetic wave by other equipments not having been detected, it progresses to step S2 and a NFC communication device processes processing of the initiator in the passive mode which sets the communicate mode as the passive mode or the active mode, and mentions it later, or the initiator in the active mode. And a NFC communication device repeats the same processing return and the following to step S1 after termination of the processing.

[0133]

Here, in step S2, the communicate mode of a NFC communication device may be set

as any of the passive mode or the active modes, as mentioned above. However, when a target cannot turn into only a target in the passive modes, such as an IC card of the existing IC card system, at step S2, a NFC communication device needs to set the communicate mode as the passive mode, and needs to process the initiator in the passive mode.

[0134]

When it is judged with the electromagnetic wave by other equipments having been detected in step S1 on the other hand (i.e., when the electromagnetic wave by other equipments is detected around a NFC communication device), it progresses to step S3 and a NFC communication device judges whether the electromagnetic wave detected at step S1 is continue being detected.

[0135]

In step S3, when judged with an electromagnetic wave continuing being detected, it progresses to step S4 and a NFC communication device processes the target in the passive mode which sets the communicate mode as the passive mode, and mentions it later. Namely, it is the case which is continuing outputting the electromagnetic wave which started the output by initial RFCA processing by becoming the initiator in the passive mode, and a NFC communication device processes by other equipments with which the case where an electromagnetic wave is continuing being detected approaches for example, a NFC communication device serving as a target in the passive mode. And the same processing is repeated by step S1 return and the following after termination of the processing.

[0136]

Moreover, in step S3, when judged with an electromagnetic wave continuing being detected, it progresses to step S5 and a NFC communication device processes the target in the active mode which sets the communicate mode as the active mode, and mentions it later. That is, since other equipments with which the case where an electromagnetic wave is continuing being detected approaches for example, a NFC communication device are the cases which started the output of an electromagnetic wave by initial RFCA processing by becoming the initiator in the active mode, and suspended the output of the electromagnetic wave after that, they serve as a target in the active mode, and a NFC communication device processes. And the same processing is repeated by step S1 return and the following after termination of the processing.

[0137]

Next, with reference to the flow chart of drawing 14 , processing of the initiator in the passive mode by the NFC communication device is explained.

[0138]

In processing of the initiator in the passive mode, a NFC communication device starts the output of an electromagnetic wave in step S11 first. In addition, in step S1 of above-mentioned drawing 13 , step S11 in processing of the initiator in this passive mode is performed, when an electromagnetic wave is not detected. That is, in step S1 of drawing 13 , a NFC communication device starts the output of an electromagnetic wave in step S11, when an electromagnetic wave is not detected. Therefore, processing of steps S1 and S11 is equivalent to above-mentioned initial RFCA processing.

[0139]

Then, it progresses to step S12, and a NFC communication device sets the variable n showing a transmission rate to 1 as initial value, and progresses to step S13. At step S13, a NFC communication device is the n-th transmission rate (suitably henceforth the n-th rate), transmits a polling request frame and progresses to step S14. At step S14, from other equipments, a NFC communication device is the n-th rate, and judges whether the polling response frame has been transmitted.

[0140]

When it is judged [ that a polling response frame has not been transmitted and ] from other equipments in step S14, Namely, for example, other equipments close to a NFC communication device cannot perform a communication link at the n-th rate. When the polling response frame to the polling request frame transmitted at the n-th rate does not come on the contrary, or when other equipments do not exist in a perimeter, step S15 thru/or S19 are skipped, and it progresses to step S20.

[0141]

Moreover, when it is judged with the polling response frame having been transmitted at the n-th rate from other equipments in step S14, Namely, for example, other equipments close to a NFC communication device can perform a communication link at the n-th rate. When the polling response frame to the polling request frame transmitted at the n-th rate comes on the contrary, it progresses to step S15 and judges whether the NFC communication device was able to carry out normal reception of the polling response frame from other equipments. When judged with the ability of normal reception of the polling response frame from other equipments to have not been carried out in step S15, Namely, since two or more equipments existed in the perimeter of a NFC communication device and the polling response frame has been transmitted to it by the same time slot from two or more of the equipments, [ for

example, ] When collision arises and a NFC communication device is not able to carry out normal reception of the polling response frame, step S16 thru/or S19 are skipped, and it progresses to step S20.

[0142]

When judged with the ability of normal reception of the polling response frame from other equipments to have been carried out in step S15, it progresses to step S16. Moreover, a NFC communication device Other equipments which have returned the polling response frame as a target in the passive mode It judges whether NFCID already memorized at step S17 to which NFCID of the target is recognized by NFCID arranged at the polling response frame, and the NFCID mentions it later is overlapped.

[0143]

In step S16, when it judges that NFCID arranged from other equipments to a polling response frame overlaps already memorized NFCID, step S17 thru/or S19 are skipped, and it progresses to step S20.

[0144]

In step S16, moreover, NFCID arranged from other equipments to a polling response frame When judged with not overlapping already memorized NFCID, it progresses to step S17. A NFC communication device While memorizing as NFCID which specifies the target which is the equipment of other about NFCID arranged from other equipments to a polling response frame, it recognizes that the target can communicate at the n-th rate.

[0145]

Here, if a NFC communication device recognizes that the target can communicate with NFCID of the target in the passive mode at the n-th rate in step S17, the transmission rate between the target is determined as the n-th rate (temporarily), and the target will communicate at the n-th rate, unless a transmission rate is changed by command PSL_REQ.

[0146]

Moreover, NFCID of the target which the NFC communication device memorized at step S17 is eliminated from a NFC communication device, for example, when the communication link with the target is completed completely.

[0147]

Then, it progresses to step S18, and a NFC communication device transmits command DSL_REQ to the target (target in the passive mode) of NFCID memorized at step S17 at the n-th rate, thereby, it is changed into a DISEREKUTO condition and progresses to step S19 so that the target may not answer the polling request frame transmitted henceforth.

[0148]

At step S19, a NFC communication device receives response DSL_RES which the target made a DISEREKUTO condition by the command DSL_REQ returns to command DSL_REQ which transmitted at step S18, and progresses to step S20.

[0149]

In step S20, at step S13, a NFC communication device judges whether predetermined time amount passed, after transmitting a polling request frame at the n-th rate. Here, predetermined time amount in step S20 can be made into zero or more time amount.

[0150]

In step S20, after transmitting a polling request frame at the n-th rate by step S13, when it is still judged with predetermined time amount having not passed, step S14 thru/or processing of S20 are repeated by step S14 return and the following.

[0151]

Here, by repeating step S14 thru/or processing of S20, a NFC communication device can receive the polling response frame transmitted to the timing of a different time slot, as drawing 11 explained.

[0152]

On the other hand, after transmitting a polling request frame at the n-th rate by step S13, when it is judged with predetermined time amount having passed in step S20, it progresses to step S21 and judges whether a NFC communication device is equal to N whose variable n is the maximum. In step S21, when it judges that Variable n is not equal to Maximum N (i.e., when Variable n is under the maximum N), it progresses to step S22, and only 1 increments Variable n and, as for a NFC communication device, step S13 thru/or processing of S22 are repeated by step S13 return and the following in it.

[0153]

Here, while a NFC communication device is a transmission rate as N by repeating step S13 thru/or processing of S22 and transmitting a polling request frame, the polling response frame which comes by each transmission rate on the contrary is received.

[0154]

When it judges that Variable n is equal to Maximum N, on the other hand in step S21, a NFC communication device at the transmission rate as N as N While transmitting a polling request frame, when the polling response frame which comes by each transmission rate on the contrary is received, it progresses to step S23. A NFC communication device It originates in the polling response frame having been

transmitted to coincidence from two or more equipments etc. It judges whether there were some which overlap into NFCID of other equipments recognized whether there was any polling response frame which was not able to carry out normal reception at step S16.

[0155]

In step S23, when judged with there having been some which overlap into NFCID of other equipments which it was judged with there having been a polling response frame which was not able to carry out normal reception, or have been recognized at step S16, the same processing is repeated by step S12 return and the following. It retransmits a message to a polling request frame to the equipment which can identify meaning, such as equipment which has transmitted by this the polling response frame in which an initiator was not able to carry out normal reception, and equipment which has transmitted overlapping NFCID, and which was not able to acquire normal NFCID so to speak.

[0156]

When judged with there being nothing that overlaps into NFCID of other equipments which it was judged with on the other hand there being no polling response frame which was not able to carry out normal reception in step S23, and have been recognized at step S16, it progresses to step S24 and a NFC communication device performs the communications processing (communications processing of the initiator in the passive mode) as an initiator in the passive mode. Here, about the communications processing of the initiator in the passive mode, it mentions later.

[0157]

And after the communications processing of the initiator in the passive mode is completed, a NFC communication device progresses to S25 from step S24, suspends the output of the electromagnetic wave which started the output at step S11, and ends processing.

[0158]

Next, with reference to the flow chart of drawing 15 , processing of the target in the passive mode by the NFC communication device is explained.

[0159]

In processing of the target in the passive mode, first, in step S31, a NFC communication device sets the variable n showing a transmission rate to 1 as initial value, and progresses to step S32. At step S32, from other equipments used as the initiator in the passive mode, a NFC communication device is the n-th rate, and judges whether the polling request frame has been transmitted.

[0160]

In step S32, when judged [ that a polling request frame has not been transmitted and ] from the initiator in the passive mode (i.e., when other equipments close to for example, a NFC communication device cannot perform a communication link at the n-th rate and cannot transmit a polling request frame at the n-th rate), it progresses to step S33 and judges whether a NFC communication device is equal to N whose variable n is the maximum. In step S33, when it judges that Variable n is not equal to Maximum N (i.e., when Variable n is under the maximum N), it progresses to step S34, and only 1 increments Variable n and, as for a NFC communication device, step S32 thru/or processing of S34 are repeated by step S32 return and the following in it.

[0161]

Moreover, in step S33, when it judges that Variable n is equal to Maximum N, step S31 thru/or processing of S34 are repeated by step S31 return and the following. That is, step S31 thru/or processing of S34 are repeated here until the polling request frame transmitted in either of the transmission rates as N is receivable from the initiator in the passive mode.

[0162]

And in step S32, when judged with the polling request frame having been transmitted from the initiator in the passive mode (i.e., when a NFC communication device carries out normal reception of the polling request frame of the n-th rate), it progresses to step S35, and with a random number, a NFC communication device generates own NFCID and progresses to step S36 while determining the transmission rate between initiators as the n-th rate. At step S36, a NFC communication device transmits the polling response frame which has arranged own NFCID at the n-th rate, and progresses to step S37.

[0163]

Here, a NFC communication device communicates at the n-th rate, unless modification of a transmission rate is directed by transmitting command PSL_REQ from the initiator in the passive mode at step S36, after transmitting a polling response frame at the n-th rate.

[0164]

At step S37, a NFC communication device repeats the same processing return and the following to step S31, when it judges [ judging whether command DSL_REQ has been transmitted and not having been transmitted from the initiator in the passive mode, and ].

[0165]

That is, in the passive mode, when a target transmits a polling response frame to the polling request frame transmitted from the initiator, fundamentally, an initiator transmits command DSL_REQ to the target, as step S18 of drawing 14 explained. That an initiator does not transmit command DSL_REQ exceptionally so to speak to a target is the case where NFCID arranged at the polling response frame overlaps NFCID of the target which the initiator has already memorized, even if it can carry out normal reception of the case where normal reception of the polling response frame is not able to be carried out by collision, or the polling response frame, as drawing 14 explained. That is, an initiator does not transmit command DSL_REQ which transmits in step S18 of drawing 14 to the target which was not able to acquire NFCID (normal NFCID) discriminable from other targets.

[0166]

Therefore, in step S37, when judged [ that command DSL_REQ has not been transmitted and ], an initiator is the case where normal NFCID of the NFC communication device which is a target is unacquirable. For this reason, in the NFC communication device used as the target in the passive mode, receiving the polling request frame to which S31 retransmits a message from return and the same processing as the case where it mentions above, i.e., an initiator, from step S37, carrying out regeneration of the new NFCID with a random number, and including and retransmitting a message to a polling response frame is repeated.

[0167]

When it is judged with command DSL_REQ having been transmitted from the initiator in the passive mode in step S37 on the other hand (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S38, and a NFC communication device transmits response DSL_REQ to command DSL_REQ, will be in a DISEREKUTO condition, and will progress to step S39.

[0168]

At step S39, a NFC communication device ends processing, after performing the communications processing (communications processing of the target in the passive mode) and completing the communications processing of the target in the passive mode as a target in the passive mode. In addition, about the communications processing of the target in the passive mode, it mentions later.

[0169]

Next, with reference to the flow chart of drawing 16 , processing of the initiator in the active mode by the NFC communication device is explained.

[0170]

In processing of the initiator in the active mode, step S11 of processing of the initiator in the passive mode of drawing 14 thru/or the respectively same processing as the case in S24 are performed in step S51 thru/or S64. However, in processing of the initiator in the passive mode of drawing 14 , a NFC communication device continues outputting an electromagnetic wave until the processing is completed, but in processing of the initiator in the active mode, only when a NFC communication device transmits data, the points which output an electromagnetic wave differ.

[0171]

That is, in step S51, a NFC communication device starts the output of an electromagnetic wave.

In addition, in step S1 of above-mentioned drawing 13 , step S51 in processing of the initiator in this active mode is performed, when an electromagnetic wave is not detected. That is, in step S1 of drawing 13 , a NFC communication device starts the output of an electromagnetic wave in step S51, when an electromagnetic wave is not detected. Therefore, processing of steps S1 and S51 is equivalent to above-mentioned initial RFCA processing.

[0172]

Then, it progresses to step S52, and a NFC communication device sets the variable n showing a transmission rate to 1 as initial value, and progresses to step S53. At step S53, a NFC communication device is the n-th rate, it transmits a polling request frame, suspends the output of an electromagnetic wave (it is said suitably that RF off processing is performed hereafter), and progresses to step S54.

[0173]

Here, at step S53, a NFC communication device starts the output of an electromagnetic wave by above-mentioned active RFCA processing, before transmitting a polling request frame. However, in processing of the initiator in the active mode of drawing 16 , when processing of step S53 is performed first, since the output of an electromagnetic wave is already started by the initial RFCA processing corresponding to step S1 of drawing 13 , and processing of drawing 16 of S51, it is not necessary by it to perform active RFCA processing.

[0174]

At step S54, from other equipments, a NFC communication device is the n-th rate, and judges whether the polling response frame has been transmitted.

[0175]

When it is judged [ that a polling response frame has not been transmitted and ] from other equipments in step S54, Namely, for example, other equipments close to a NFC

communication device cannot perform a communication link at the n-th rate. Or since other equipments do not exist near the NFC communication device, when the polling response frame to the polling request frame transmitted at the n-th rate does not come on the contrary, step S55 thru/or S59 are skipped, and it progresses to step S60.

[0176]

Moreover, when it is judged with the polling response frame having been transmitted at the n-th rate from other equipments in step S54, Namely, for example, other equipments close to a NFC communication device can perform a communication link at the n-th rate. When the polling response frame to the polling request frame transmitted at the n-th rate comes on the contrary, it progresses to step S55 and judges whether the NFC communication device was able to carry out normal reception of the polling response frame from other equipments. When judged with the ability of normal reception of the polling response frame from other equipments to have not been carried out in step S55, Namely, since two or more equipments existed in the perimeter of a NFC communication device and the polling response frame has been transmitted to it by the same time slot from two or more of the equipments, [ for example, ] When collision arises and a NFC communication device is not able to carry out normal reception of the polling response frame, step S56 thru/or S59 are skipped, and it progresses to step S60.

[0177]

When judged with the ability of normal reception of the polling response frame from other equipments to have been carried out in step S55, it progresses to step S56. Moreover, a NFC communication device Other equipments which have returned the polling response frame as a target in the active mode It judges whether NFCID already memorized at step S57 to which NFCID of the target is recognized by NFCID arranged at the polling response frame, and the NFCID already mentions it later is overlapped.

[0178]

In step S56, when it judges that NFCID arranged from other equipments to a polling response frame overlaps already memorized NFCID, step S57 thru/or S59 are skipped, and it progresses to step S60.

[0179]

In step S56, moreover, NFCID arranged from other equipments to a polling response frame When judged with not overlapping already memorized NFCID, it progresses to step S57. A NFC communication device While memorizing as NFCID which specifies the target which is the equipment of other about NFCID arranged from other equipments to a polling response frame, it recognizes that the target can communicate at the n-th rate.

[0180]

Here, if a NFC communication device recognizes that the target can communicate with NFCID of the target in the active mode at the n-th rate in step S57, the transmission rate between the target is determined as the n-th rate, and the target will communicate at the n-th rate, unless a transmission rate is changed by command PSL_REQ.

[0181]

Moreover, NFCID of the target which the NFC communication device memorized at step S57 is eliminated from a NFC communication device, for example, when the communication link with the target is completed completely.

[0182]

Then, it progresses to step S58, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits command DSL_REQ to the target (target in the active mode) of NFCID memorized at step S55 at the n-th rate.

Thereby, the target will be in the DISEREKUTO condition which does not answer the polling request frame transmitted henceforth. Then, a NFC communication device performs RF off processing, and progresses to S59 from step S58.

[0183]

At step S59, a NFC communication device receives response DSL_RES which the target made a DISEREKUTO condition by the command DSL_REQ returns to command DSL_REQ which transmitted at step S58, and progresses to step S60.

[0184]

In step S60, at step S53, a NFC communication device judges whether predetermined time amount passed, after transmitting a polling request frame at the n-th rate.

[0185]

In step S60, after transmitting a polling request frame at the n-th rate by step S53, when it is still judged with predetermined time amount having not passed, step S54 thru/or processing of S60 are repeated by step S54 return and the following.

[0186]

On the other hand, after transmitting a polling request frame at the n-th rate by step S53, when it is judged with predetermined time amount having passed in step S60, it progresses to step S61 and judges whether a NFC communication device is equal to N whose variable n is the maximum. In step S61, when it judges that Variable n is not

equal to Maximum N (i.e., when Variable n is under the maximum N), it progresses to step S62, and only 1 increments Variable n and, as for a NFC communication device, step S53 thru/or processing of S62 are repeated by step S53 return and the following in it.

[0187]

Here, while a NFC communication device is a transmission rate as N by repeating step S53 thru/or processing of S62 and transmitting a polling request frame, the polling response frame which comes by each transmission rate on the contrary is received.

[0188]

When it judges that Variable n is equal to Maximum N, on the other hand in step S61, a NFC communication device at the transmission rate as N as N While transmitting a polling request frame, when the polling response frame which comes by each transmission rate on the contrary is received, it progresses to step S63. A NFC communication device It originates in the polling response frame having been transmitted to coincidence from two or more equipments etc. It judges whether there were some which overlap into NFCID of other equipments recognized whether there was any polling response frame which was not able to carry out normal reception at step S56.

[0189]

In step S63, when judged with there having been some which overlap into NFCID of other equipments which it was judged with there having been a polling response frame which was not able to carry out normal reception, or have been recognized at step S56, the same processing is repeated by step S52 return and the following. It retransmits a message to a polling request frame to the equipment which has transmitted by this the polling response frame in which an initiator was not able to carry out normal reception, and the equipment which has transmitted overlapping NFCID.

[0190]

When judged with there being nothing that overlaps into NFCID of other equipments which it was judged with on the other hand there being no polling response frame which was not able to carry out normal reception in step S63, and have been recognized at step S56, it progresses to step S64, and as an initiator in the active mode, a NFC communication device performs the communications processing (communications processing of the initiator in the active mode), and ends processing after that. Here, about the communications processing of the initiator in the active mode, it mentions later.

[0191]

Next, with reference to the flow chart of drawing 17 , processing of the target in the active mode by the NFC communication device is explained.

[0192]

In processing of the target in the active mode, step S31 of processing of the target in the passive mode of drawing 15 thru/or the respectively same processing as the case in S39 are performed in step S71 thru/or S79. However, although data are transmitted in processing of the target in the passive mode of drawing 15 when a NFC communication device carries out the load modulation of the electromagnetic wave which the initiator in the passive mode outputs, it differs in processing of the target in the active mode in that a NFC communication device outputs an electromagnetic wave in person, and data are transmitted.

[0193]

That is, in processing of the target in the active mode, step S31 of drawing 15 thru/or the respectively same processing as the case in S35 are performed in step S71 thru/or S75.

[0194]

And it progresses to step S76 after processing of step S75, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits the polling response frame which has arranged own NFCID at the n-th rate. Furthermore, at step S76, a NFC communication device performs RF OFF processing, and progresses to step S77.

[0195]

Here, a NFC communication device communicates at the n-th rate, unless modification of a transmission rate is directed by transmitting command PSL_REQ from the initiator in the active mode at step S76, after transmitting a polling response frame at the n-th rate.

[0196]

At step S77, a NFC communication device repeats the same processing return and the following to step S71, when it judges [ judging whether command DSL_REQ has been transmitted and not having been transmitted from the initiator in the active mode, and ].

[0197]

That is, in the active mode, when a target transmits a polling response frame to the polling request frame transmitted from the initiator, fundamentally, an initiator transmits command DSL_REQ to the target, as step S58 of drawing 16 explained. That

an initiator does not transmit command DSL_REQ exceptionally so to speak to a target is the case where NFCID arranged at the polling response frame overlaps NFCID of the target which the initiator has already memorized, even if it can carry out normal reception of the case where normal reception of the polling response frame is not able to be carried out by collision, or the polling response frame, as drawing 16 explained. That is, an initiator does not transmit command DSL_REQ which transmits in step S58 of drawing 16 to the target which was not able to acquire NFCID (normal NFCID) discriminable from other targets.

[0198]

Therefore, in step S77, when judged [ that command DSL_REQ has not been transmitted and ], an initiator is the case where normal NFCID of the NFC communication device which is a target is unacquirable. For this reason, in the NFC communication device used as the target in the active mode, receiving the polling request frame to which S71 retransmits a message from return and the same processing as the case where it mentions above, i.e., an initiator, from step S77, carrying out regeneration of the new NFCID with a random number, and including and retransmitting a message to a polling response frame is repeated.

[0199]

When it is judged with command DSL_REQ having been transmitted from the initiator in the passive mode in step S77 on the other hand (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S78, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits response DSL_REQ to command DSL_REQ. Furthermore, at step S78, a NFC communication device performs RF OFF processing, will be in a DISEREKUTO condition, and will progress to step S79.

[0200]

At step S79, a NFC communication device ends processing, after performing the communications processing (communications processing of the target in the active mode) and completing the communications processing of the target in the active mode as a target in the active mode. In addition, about the communications processing of the target in the active mode, it mentions later.

[0201]

Next, with reference to the flow chart of drawing 18 and drawing 19 , the communications processing of the initiator in the passive mode in step S24 of drawing 14 is explained.

[0202]

In step S91, the NFC communication device which is the initiator in the passive mode chooses the equipment (suitably henceforth attention equipment) which communicates from the targets which memorized NFCID at step S15 of drawing 14 , and progresses to step S92. At step S92, command WUP_REQ is transmitted to attention equipment and this cancels the DISEREKUTO condition of the attention equipment made into the DISEREKUTO condition by transmitting command DSL_REQ at step S19 of drawing 14 (it is suitably said for the Wake rise that it carries out hereafter).

[0203]

Then, attention equipment waits to transmit response WUP_RES to command WUP_REQ, and progresses to S93 from step S92, and a NFC communication device receives the response WUP_RES, and progresses to step S94. At step S94, a NFC communication device transmits command ATR_REQ to attention equipment. And attention equipment waits to transmit response ATR_RES to command ATR_REQ, and progresses to S95 from step S94, and a NFC communication device receives the response ATR_RES.

[0204]

Here, a NFC communication device and attention equipment recognize mutually the transmission rate with which a partner can communicate because a NFC communication device and attention equipment exchange command ATR_REQ by which an attribute is arranged as mentioned above, and response ATR_RES.

[0205]

Then, it progresses to S96 from step S95, and a NFC communication device transmits command DSL_REQ to attention equipment, and changes attention equipment into a DISEREKUTO condition. And attention equipment waits to transmit response DSL_RES to command DSL_REQ, and progresses to S97 from step S96, and a NFC communication device receives the response DSL_RES, and progresses to step S98.

[0206]

At step S98, it judges whether the NFC communication device chose all the targets that memorized NFCID at step S17 of drawing 14 as attention equipment at step S91. In step S98, when a NFC communication device judges with there being a target which has not been chosen as attention equipment yet, to step S91, return and a NFC communication device are newly [ one ] of the targets which have not been chosen as attention equipment chosen as attention equipment, and still repeat the same processing hereafter.

[0207]

In step S98, a NFC communication device moreover, all the targets that memorized NFCID at step S17 of drawing 14 When it judges with having chosen as attention equipment at step S91, a NFC communication device among all the targets that memorized NFCID Command ATR_REQ and response ATR_RES are exchanged. By this When the transmission rate with which each target can communicate has been recognized, it progresses to step S99. A NFC communication device The equipment (attention equipment) which communicates is chosen from the targets which exchanged command ATR_REQ and response ATR_RES at steps S94 and S95, and it progresses to step S100.

[0208]

At step S100, a NFC communication device transmits command WUP_REQ to attention equipment, and, thereby, carries out the Wake rise of the attention equipment made into the DISEREKUTO condition by transmitting command DSL_REQ at step S96. And attention equipment waits to transmit response WUP_RES to command WUP_REQ, and progresses to S101 from step S100, and a NFC communication device receives the response WUP_RES, and progresses to step S111 of drawing 19 .

[0209]

At step S111, a NFC communication device judges whether communications parameters, such as a transmission rate at the time of performing a communication link with attention equipment, are changed.

[0210]

Here, at step S95 of drawing 18 , the NFC communication device has received response ATR_RES from attention equipment, and recognizes communications parameters, such as a transmission rate with which attention equipment can communicate, based on the attribute arranged at the response ATR_RES. A NFC communication device judges with changing a communications parameter in step S111 between for example, attention equipment, that a transmission rate should be changed into a more nearly high-speed transmission rate, when it can communicate at a high-speed transmission rate rather than a current transmission rate. Moreover, when current communication environment is an environment where a noise level is high, in order to fall a transmission error that a NFC communication device can communicate at a low-speed transmission rate rather than a current transmission rate between for example, attention equipment, in step S111, it judges with changing a communications parameter that a transmission rate should be changed into a low speed transmission rate. In addition, even if it is the case which can communicate at a different transmission rate from a current transmission rate between a NFC communication device and attention equipment, it is possible to continue a communication link with a current transmission rate.

[0211]

In step S111, when judged with not changing the communications parameter at the time of performing a communication link with attention equipment (i.e., when continuing a communication link between a NFC communication device and attention equipment with current communications parameters, such as a current transmission rate), step S112 thru/or S114 are skipped, and it progresses to step S115.

[0212]

Moreover, in step S111, when judged with changing the communications parameter at the time of performing a communication link with attention equipment, it progresses to step S112, and a NFC communication device arranges the value of the communications parameter after the modification to command PSL_REQ, and transmits it to attention equipment. And attention equipment waits to transmit response PSL_RES to command PSL_REQ, and progresses to S113 from step S112, and a NFC communication device receives the response PSL_RES, and progresses to step S114.

[0213]

A NFC communication device is changed into the value of the communications parameter which has arranged communications parameters, such as a transmission rate at the time of performing the communication link with attention equipment, to command PSL_REQ which transmitted at step S112 at step S114. A NFC communication device performs the communication link with attention equipment according to communications parameters, such as a transmission rate of the value changed at step S114, unless the exchange of command PSL_REQ and response PSL_RES is henceforth carried out again between attention equipment.

[0214]

In addition, according to the exchange (negotiation) of command PSL_REQ and response PSL_RES, it is possible to also make a change of encoding methods other than [ 16 (decoding section 14) ] a transmission rate (for example, the encoding section of drawing 4 ), the modulation technique of the modulation section 19 and the load modulation section 20 (recovery section 13), etc.

[0215]

Then, it progresses to step S115, and when it judges whether there are any data which should be transmitted and received between attention equipment and is judged with

there being nothing, a NFC communication device skips steps S116 and S117, and progresses to step S118.

[0216]

Moreover, in step S115, when judged with there being data which should be transmitted and received between attention equipment, it progresses to step S116 and a NFC communication device transmits command DEP_REQ to attention equipment. Here, at step S116, when there are data which should be transmitted to attention equipment, a NFC communication device arranges the data to command DEP_REQ, and is transmitted.

[0217]

And attention equipment waits to transmit response DEP_RES to command DEP_REQ, and progresses to S117 from step S116, and a NFC communication device receives the response DEP_RES, and progresses to step S118.

[0218]

As mentioned above, the so-called transmission and reception of live data are performed by exchanging command DEP_REQ and response DEP_RES between a NFC communication device and attention equipment.

[0219]

At step S118, a NFC communication device judges whether a communications partner is changed. In step S118, when judged with not changing a communications partner (i.e., when there are still data exchanged between attention equipment for example), the same processing is repeated by step S111 return and the following.

[0220]

Moreover, in step S118, when judged with changing a communications partner (i.e., although there are no data exchanged between for example, attention equipment, when there are data exchanged with other communications partners), it progresses to step S119 and a NFC communication device transmits command DSL_REQ or RLS_REQ to attention equipment. And attention equipment waits to transmit response DSL_RES or RLS_RES to command DSL_REQ or RLS_REQ, and progresses to S120 from step S119, and a NFC communication device receives the response DSL_RES or RLS_RES.

[0221]

Here, as mentioned above, when a NFC communication device transmits command DSL_REQ or RLS_REQ to attention equipment, the target as the attention equipment is released from the object of the communication link with the NFC communication device as an initiator. However, although the target released by command DSL_REQ will be in an initiator and the condition which can be communicated again by command WUP_UP, the target released by command RLS_REQ will not be in an initiator and the condition which can be communicated, unless the exchange of the polling request frame mentioned above and a polling response frame is performed between initiators.

[0222]

In addition, as a case where a certain target is released from the object of the communication link with an initiator, others, for example, an initiator, and a target in case command DSL_REQ or RLS_REQ is transmitted from an initiator to a target separate too much, and there is a case where it becomes impossible to perform a contiguity communication link, as mentioned above. In this case, like the target released by command RLS_REQ, between a target and an initiator, unless the exchange of a polling request frame and a polling response frame is performed, it will not be in an initiator and the condition which can be communicated.

[0223]

Here, hereafter, suitably, between a target and an initiator, if the exchange of a polling request frame and a polling response frame is not performed, release of the target an initiator and whose communication link are not attained will be called full release. Moreover, release of the target an initiator and whose communication link are attained again is called release by transmitting command WUP_UP from an initiator temporarily.

[0224]

After processing of step S120 progresses to step S121, and a NFC communication device judges whether full release of all the targets that memorized NFCID at step S17 of drawing 14 was carried out. In step S121, when judged with full release of all the targets that memorized NFCID not being carried out yet, to step 99 of drawing 18 , return and a NFC communication device newly choose attention equipment, and repeat the same processing hereafter out of the target by which full release is not carried out, i.e., the target released temporarily.

[0225]

Moreover, in step S121, when judged with full release of all the targets that memorized NFCID having been carried out, processing is ended.

[0226]

In addition, in steps S116 and S117 of drawing 19 , although transmission and reception (data exchange) of data are performed between a target and an initiator by exchanging command DEP_REQ and response DEP_RES, the exchange of this command DEL_REQ and response DEP_RES is one transaction. Through steps S118, S111, S112, and S113, after processing of steps S116 and S117 can be returned to

step S114, and can change a communications parameter. Therefore, communications parameters, such as a transmission rate about the communication link between a target and an initiator, can be changed for every transaction.

[0227]

Moreover, in steps S112 and S113, it is possible by exchanging command PSL_REQ and response PSL_RES between an initiator and a target to change the communicate mode of the initiator which is one of the communications parameters, and a target at step S114. Therefore, the communicate mode of a target and an initiator can be changed for every transaction. In addition, this means that the communicate mode of a target and an initiator must not be changed between one transaction.

[0228]

Next, with reference to the flow chart of drawing 20 , the communications processing of the target in the passive mode in step S39 of drawing 15 is explained .

[0229]

In steps S37 and S38 of drawing 15 , since the NFC communication device which is the target in the passive mode is considering the exchange of response DSL_RES as command DSL_REQ between the initiators in the passive mode, it is in the DISEREKUTO condition.

[0230]

Then, in step S131, a NFC communication device is considered as as [ return and a DISEREKUTO condition ] at step S131, when it judges whether command WUP_REQ has been transmitted from the initiator and it is judged [ not having been transmitted and ].

[0231]

Moreover, in step S131, when judged with command WUP_REQ having been transmitted from the initiator (i.e., when a NFC communication device receives command WUP_REQ), it progresses to step S131, and a NFC communication device transmits response WUP_RES to command WUP_REQ, carries out the Wake rise, and progresses to step S133.

[0232]

At step S133, command ATR_REQ judges whether it has been transmitted from the initiator, and when it judges [ not having been transmitted and ], a NFC communication device skips step S134, and progresses to step S135.

[0233]

Moreover, in step S133, when judged with command ATR_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command ATR_REQ), it progresses to step S135, and a NFC communication device transmits response ATR_RES to command ATR_REQ, and progresses to step S135.

[0234]

At step S135, a NFC communication device judges whether command DSL_REQ has been transmitted from the initiator. In step S135, when judged with command DSL_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S136, and a NFC communication device transmits response DSL_RES to command DSL_REQ, and returns to step S131. Thereby, a NFC communication device will be in a DISEREKUTO condition.

[0235]

On the other hand, when it is judged [ that command DSL_REQ has not been transmitted and ] from an initiator in step S135, it progresses to step S137, and a NFC communication device judges whether command PSL_REQ has been transmitted from the initiator, when it judges [ not having been transmitted and ], it skips steps S138 and S139, and progresses to step S140.

[0236]

Moreover, in step S137, when judged with command PSL_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command PSL_REQ), it progresses to step S138, and a NFC communication device transmits response PSL_RES to command PSL_REQ, and progresses to step S139. At step S139, according to command PSL_REQ from an initiator, a NFC communication device changes the communications parameter, and progresses to step S140.

[0237]

At step S140, when it judges [ judging whether command DEP_REQ has been transmitted and not having been transmitted from an initiator, and ], a NFC communication device skips step S141, and progresses to step S142.

[0238]

Moreover, in step S140, when judged with command DEP_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command DEP_REQ), it progresses to step S141, and a NFC communication device transmits response DEP_RES to command DEP_REQ, and progresses to step S142.

[0239]

At step S142, when it judges [ that a NFC communication device judges whether command RSL_REQ has been transmitted, and has not been transmitted from an initiator, and ], the same processing is repeated by step S133 return and the following.

[0240]

Moreover, in step S142, when judged with command RSL_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command RSL_REQ), it progresses to step S143, and a NFC communication device transmits response RSL_RES to command RSL_REQ, thereby, it ends the communication link with an initiator completely, and ends processing.

[0241]

Next, drawing 21 and drawing 22 are flow charts which show the detail of the communications processing of the initiator in the active mode in step S64 of drawing 16 .

[0242]

In addition, by the communications processing of the initiator in the passive mode explained by drawing 18 and drawing 19 , although an initiator is continuing outputting an electromagnetic wave, by the communications processing of the initiator in the active mode of drawing 21 and drawing 22 , by performing active RFCA processing, before transmitting a command, an initiator starts the output of an electromagnetic wave and performs processing (OFF processing) which suspends the output of the electromagnetic wave after termination of transmission of a command. If this point is removed, since the step step S91 of drawing 18 step S111 of S101 and drawing 19 thru/or the respectively same processing as the case in S121 are performed, by the communications processing of the initiator in the active mode of drawing 21 , the explanation will be omitted in step S151 step S171 of S161 and drawing 22 thru/or S181.

[0243]

Next, drawing 23 is a flow chart which shows the detail of the communications processing of the target in the active mode in step S79 of drawing 17 .

[0244]

In addition, although data are transmitted in the communications processing of the target in the passive mode explained by drawing 20 when a target carries out the load modulation of the electromagnetic wave which the initiator is outputting In the communications processing of the target in the active mode of drawing 23 , a target starts the output of an electromagnetic wave by performing active RFCA processing, before transmitting a command, and performs processing (OFF processing) which suspends the output of the electromagnetic wave after termination of transmission of a command. If this point is removed, since step S131 of drawing 20 thru/or the respectively same processing as the case in S143 are performed, by the communications processing of the target in the active mode of drawing 23 , the explanation will be omitted in step S191 thru/or S203.

[0245]

As mentioned above, in an initiator, NFCID arranged at the polling response frame which the polling request frame which requires NFCID which identifies a target is transmitted, and a target transmits as a response to the polling request frame is acquired. And in an initiator, when NFCID of a target is not able to be acquired normally, it retransmits a message to a polling request frame. On the other hand, if the polling response frame from an initiator is received, a target will generate own NFCID with a random number, will arrange it to a polling response frame, and will be transmitted to an initiator. Furthermore, when a polling request frame is re-received from an initiator, a target carries out regeneration of the own NFCID with a random number, arranges it to a polling response frame, and is broadcast again to an initiator.

[0246]

Therefore, when two or more targets are close to the perimeter of an initiator, about each of two or more of the targets, an initiator can acquire unique NFCID and can identify two or more targets of each certainly by the NFCID. Consequently, it can prevent that a response is transmitted to coincidence from two or more targets to the command which the initiator transmitted to certain addressing to NFCID.

[0247]

Moreover, since the random number generated NFCID, it is not necessary to prepare in equipment EEPROM for memorizing the NFCID which is needed when the unique number of immobilization etc. is set to NFCID, and enables manufacture etc. to carry out equipment by low cost.

[0248]

In addition, it is not necessary to necessarily process the processing step explaining the processing which a NFC communication device performs to time series in accordance with the sequence indicated as a flow chart, and it is a juxtaposition thing also including the processing (for example, parallel processing or processing by the object) performed according to an individual in this specification.

[0249]

Moreover, after an initiator acquires NFCID of all the targets in the approaching location with the gestalt of this operation, Although the Wake rise only of the attention equipment is carried out from a DISEREKUTO condition and other targets were kept carried out in the DISEREKUTO condition when communicating by using a certain target as attention equipment After acquiring NFCID of all the targets in the

approaching location, it is possible for it to be made to communicate by carrying out the Wake rise of all those targets. In this case, it is recognized by NFCID arranged at that command whether the command which an initiator transmits is a thing to which target. That is, the target of NFCID arranged at the command will receive the command which the initiator transmitted, and the response to the command will be returned to a target.

[0250]

Furthermore, although the gestalt of this operation explained the case where this invention was applied to the NFC communication device which can transmit and receive the data in two or more transmission rates, in addition to this, this invention is applicable to the communication device which can only transmit and receive the data in a certain single transmission rate. Furthermore, this invention is applicable also to the communication device which communicates only with either the passive mode or the active modes.

[0251]

[Effect of the Invention]

According to this invention, like the above, it can prevent that a response comes to coincidence on the contrary from two or more communications partners.

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the example of a configuration of the gestalt of 1 operation of the communication system which applied this invention.

[Drawing 2] It is drawing explaining the passive mode.

[Drawing 3] It is drawing explaining the active mode.

[Drawing 4] It is the block diagram showing the example of a configuration of the NFC communication device 1.

[Drawing 5] It is the block diagram showing the example of a configuration of the recovery section 13.

[Drawing 6] It is the block diagram showing the example of a configuration of the modulation section 19.

[Drawing 7] It is the block diagram showing other examples of a configuration of the recovery section 13.

[Drawing 8] It is the block diagram showing the example of a configuration of further others of the recovery section 13.

[Drawing 9] It is a timing chart explaining initial RFCA processing.

[Drawing 10] It is a timing chart explaining active RFCA processing.

[Drawing 11] It is drawing explaining SDD processing.

[Drawing 12] It is drawing showing the list of a command and responses.

[Drawing 13] It is a flow chart explaining processing of a NFC communication device.

[Drawing 14] It is the flow chart which shows processing of the initiator in the passive mode.

[Drawing 15] It is the flow chart which shows processing of the target in the passive mode.

[Drawing 16] It is the flow chart which shows processing of the initiator in the active mode.

[Drawing 17] It is the flow chart which shows processing of the target in the active mode.

[Drawing 18] It is the flow chart which shows the communications processing of the initiator in the passive mode.

[Drawing 19] It is the flow chart which shows the communications processing of the initiator in the passive mode.

[Drawing 20] It is the flow chart which shows the communications processing of the target in the passive mode.

[Drawing 21] It is the flow chart which shows the communications processing of the initiator in the active mode.

[Drawing 22] It is the flow chart which shows the communications processing of the initiator in the active mode.

[Drawing 23] It is the flow chart which shows the communications processing of the target in the active mode.

[Description of Notations]

1 thru/or 3 NFC communication device 11 An antenna, 12 Receive section 13 The recovery section, 14 Decoding section 15 The data-processing section, 16 Encoding section 17 The selection section, 18 Electromagnetic wave output section 19 The modulation section, 20 Load modulation section 21 A control section, 22 Power supply section 23 Detecting element 24 Random-number-generation section 31 selection sections 321 thru/or 32Ns Recovery section 33 41 Selection section 421 thru/or 42Ns Modulation section 43 Selection section 51 The adjustable rate recovery section and 52 Rate detecting element

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[Translation done.]

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## TECHNICAL FIELD

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[Field of the Invention]

Concerning a communication device and a correspondence procedure, in a contiguity communication link etc., this invention identifies two or more communications partners of each certainly, and relates to the communication device and correspondence procedure which enable it to prevent that a response comes to coincidence on the contrary from two or more communications partners.

[0002]

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[Translation done.]

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## PRIOR ART

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[Description of the Prior Art]

As a system which performs a contiguity communication link, IC (Integrated Curcuit) system is known widely, for example. In IC card system, when reader/writer generates an electromagnetic wave, the so-called RF (Radio Frequency) field (field) is formed. And by electromagnetic induction, if an IC card approaches reader/writer, an IC card will perform data transmission between reader/writers while receiving supply of a power source (for example, patent reference 1).

[0003]

As a specification of IC card system by which current operation is carried out, there are some which are called Type A, Type B, and Type C, for example.

[0004]

Type A is adopted as Philips's MIFARE method, encoding of the data based on Miller is carried out to the data transmission from reader/writer to an IC card, and encoding of the data based on Manchester is carried out to the data transmission from an IC card to reader/writer at it. Moreover, by Type A, 106kbps (kilo bit per second) is adopted as a transmission rate of data.

[0005]

By Type B, encoding of the data based on NRZ is carried out to the data transmission from reader/writer to an IC card, and encoding of the data twisted for the data transmission from an IC card to reader/writer NRZ-L is carried out to it. Moreover, by Type B, 106kbps is adopted as a transmission rate of data.

[0006]

Type C is adopted as a FeliCa method of Sony Corp. which is this applicant, and encoding of the data based on Manchester is carried out to the data transmission between reader/writer and an IC card. Moreover, by Type C, 212kbps is adopted as a transmission rate of data.

[0007]

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[Translation done.]

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## EFFECT OF THE INVENTION

[Effect of the Invention]
According to this invention, like the above, it can prevent that a response comes to coincidence on the contrary from two or more communications partners.

[Translation done.]



## TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention]
By the way, in IC card system, when two or more IC cards have approached to one reader/writer, reader/writer needs to identify each of two or more of the IC cards, and needs to communicate by specifying a communications partner.
[0008]
ID as a unique identification number is assigned to an IC card as an approach of identifying two or more IC cards, and there is an approach which the ID is made to report to reader/writer from an IC card.
[0009]
Thus, in assigning unique ID to an IC card, how [ IC card ] is carried out and ID does not overlap. However, memory, such as EEPROM (Electrically Erasable Programmable Read Only Memory) for always memorizing that unique ID in this case, is needed. Therefore, even when EEPROM is not required, it is necessary to prepare EEPROM in making ID memorize, and the manufacturing cost of an IC card becomes cost quantity to an IC card.
[0010]
Then, in an IC card, a random number is generated and there is the approach of using the random number temporarily as own ID. According to this approach, since it is not necessary to always memorize ID, it is not necessary to prepare EEPROM for making ID memorize.
[0011]
However, when using a random number as ID, in two or more IC cards, that the same random number is used as ID may arise. In this case, when reader/writer transmits data to that addressing to ID, and two or more IC cards answer coincidence, interference (collision) will arise and reader/writer can acquire the response from an IC card normally.
[0012]
This invention enables it to prevent that it is made in view of such a situation, identify two or more communications partners of each certainly, and a response comes to coincidence on the contrary from two or more communications partners.
[0013]

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## MEANS

[Means for Solving the Problem]
The 1st communication device of this invention transmits the data which require ID (Identification) which identifies other equipments. ID which other equipments transmit

according to the demand of ID is acquired. After acquisition of ID of other equipments As data to other equipments, when the data containing ID of other equipments are not able to be transmitted and ID of other equipments is not able to be acquired normally, it is characterized by broadcasting again the data which require ID.

[0014]

The 1st correspondence procedure of this invention transmits the data which require ID (Identification) which identifies other equipments. ID which other equipments transmit according to the demand of ID is acquired. After acquisition of ID of other equipments As data to other equipments, when the data containing ID of other equipments are not able to be transmitted and ID of other equipments is not able to be acquired normally, it is characterized by broadcasting again the data which require ID.

[0015]

When the data which require ID (Identification) which identifies self from other equipments are received, the 2nd communication device of this invention When a random number generates own ID, it transmits and the data which require ID are re-received from other equipments Regeneration of own ID is carried out with a random number, it is broadcast again, and it is characterized by receiving the data containing ID of the self of the data transmitted from other equipments as data to self.

[0016]

When the data which require ID (Identification) which identifies self from other equipments are received, the 2nd correspondence procedure of this invention When a random number generates own ID, it transmits and the data which require ID are re-received from other equipments Regeneration of own ID is carried out with a random number, it is broadcast again, and it is characterized by receiving the data containing ID of the self of the data transmitted from other equipments as data to self.

[0017]

In the 1st communication device and correspondence procedure of this invention, ID which the data which require ID (Identification) which identifies other equipments are transmitted, and other equipments transmit according to the demand of ID is acquired. And the data containing ID of other equipments are transmitted as data to other equipments after acquisition of ID of other equipments. On the other hand, when ID of other equipments is not able to be acquired normally, it retransmits a message to the data which require ID.

[0018]

In the 2nd communication device and correspondence procedure of this invention, when the data which require ID (Identification) which identifies self from other equipments are received, own ID is generated by the random number and transmitted. Moreover, when the data which require ID are re-received from other equipments, regeneration of own ID is carried out with a random number, and it retransmits a message to it. And the data containing ID of the self of the data transmitted from other equipments are received as data to self.

[0019]

[Embodiment of the Invention]

Drawing 1 shows the example of a configuration of the gestalt of 1 operation of the communication system (a system means the thing object which two or more equipments combined logically, and it does not ask whether the equipment of each configuration is in the same case) which applied this invention.

[0020]

In drawing 1 , communication system consists of three NFC communication devices 1, 2, and 3. the NFC communication device 1 thru/or 3 -- each can perform now the contiguity communication link (NFC (Near Field Communication)) by electromagnetic induction which used the subcarrier of a single frequency among other NFC communication devices.

[0021]

Here, as a frequency of the subcarrier which the NFC communication device 1 thru/or 3 use, 13.56 etc.MHz of an ISM (Industrial Scientific Medical) band etc. is employable, for example.

[0022]

Moreover, the communication link which means, and the equipments (case) which communicate contact and performs the communication link from which the distance of the equipments with which a contiguity communication link communicates is set to less than several 10cm, and becomes possible is also included.

[0023]

in addition, a thing employable as an IC card system which uses one or more [ other ] as an IC card while the communication system of drawing 1 makes reader/writer the NFC communication device 1 thru/or 1 or more [ of 3 ] -- of course -- the NFC communication device 1 thru/or 3 — it is also possible to adopt each as communication system, such as PDA (Personal Digital Assistant), PC (Personal Computer), a cellular phone, a wrist watch, and a pen. That is, the NFC communication device 1 thru/or 3 are equipment which performs a contiguity communication link, and is not limited to an IC card, reader/writer, etc. of IC card system.

[0024]
The NFC communication device 1 thru/or 3 have two descriptions that the communication link by the two communicate modes is possible to the 1st, and that the data transmission by two or more transmission rates is possible to the 2nd.
[0025]
There are the passive mode and the active mode as the two communicate modes. When it takes notice of the communication link between the NFC communication device 1 thru/or the NFC communication devices 1 and 2 of 3 now, in the passive mode The NFC communication device 1 which is one NFC communication device of the NFC communication devices 1 and 2 like the conventional IC card system mentioned above Data are transmitted to the NFC communication device 2 which is a NFC communication device of another side by modulating the electromagnetic wave (corresponding subcarrier) which self generates. The NFC communication device 2 By carrying out the load modulation of the electromagnetic wave (corresponding subcarrier) which the NFC communication device 1 generates, data are transmitted to the NFC communication device 1.
[0026]
On the other hand, in the active mode, all of the NFC communication devices 1 and 2 transmit data by modulating the electromagnetic wave (corresponding subcarrier) which self generates.
[0027]
When performing the contiguity communication link by electromagnetic induction here, an electromagnetic wave is outputted first, a communication link is started, and the equipment which has the communicative leadership so to speak is called an initiator. An initiator transmits a command to a communications partner, and although the communications partner is the form where the response to the command is returned and a contiguity communication link is performed, it calls a target the communications partner which returns the response to the command from an initiator.
[0028]
For example, supposing the NFC communication device 1 starts the output of an electromagnetic wave and starts the communication link with the NFC communication device 2 now, as shown in drawing 2 and drawing 3 , the NFC communication device 1 will serve as an initiator, and the NFC communication device 2 will serve as a target.
[0029]
And the NFC communication device 1 which is an initiator as shown in drawing 2 in the passive mode outputs an electromagnetic wave continuously, and while the NFC communication device 1 transmits data to the NFC communication device 2 which is a target by modulating the electromagnetic wave which self is outputting, the NFC communication device 2 transmits data to the NFC communication device 1 by carrying out the load modulation of the electromagnetic wave which the NFC communication device 1 which is an initiator is outputting.
[0030]
On the other hand, in the active mode, as shown in drawing 3 , the NFC communication device 1 which is an initiator transmits data to the NFC communication device 2 which is a target by starting the output of an electromagnetic wave in person and modulating the electromagnetic wave, when self transmits data. And the NFC communication device 1 suspends the output of an electromagnetic wave after transmitting termination of data. When self transmits data, and the NFC communication device 2 which is a target also starts the output of an electromagnetic wave in person and modulates the electromagnetic wave, data are transmitted to the NFC communication device 1 which is an initiator. And the NFC communication device 2 suspends the output of an electromagnetic wave after transmitting termination of data.
[0031]
In addition, the NFC communication device 1 thru/or 3 mention later about the 2nd focus that the data transmission by two or more transmission rates is possible.
[0032]
Moreover, although communication system is constituted from drawing 1 by three NFC communication devices 1 thru/or 3, the NFC communication device which constitutes communication system may not be limited to three, and may be 2 or 4 or more. Furthermore, communication system can also be constituted including an IC card, reader/writer, etc. which constitute other, for example, the conventional IC, card systems [ communication device / NFC ].
[0033]
Next, drawing 4 shows the example of a configuration of the NFC communication device 1 of drawing 1 . In addition, since other NFC communication devices 2 and 3 of drawing 1 as well as the NFC communication device 1 of drawing 4 are constituted, the explanation is omitted.
[0034]
The antenna 11 constitutes the coil of a closed loop, is that the current which flows in this coil changes, and outputs an electromagnetic wave. Moreover, a current flows at an antenna 11 because the magnetic flux which passes along the coil as an antenna 11

changes.

[0035]

A receive section 12 receives the current which flows at an antenna 11, performs alignment and detection, and outputs to the recovery section 13. The recovery section 13 restores to the signal supplied from a receive section 12, and supplies it to the decoding section 14. The decoding section 14 decodes the Manchester code as a signal supplied from the recovery section 13 etc., and supplies the data obtained as a result of the decoding to the data-processing section 15.

[0036]

The data-processing section 15 performs processing which should be performed with protocols, such as the transport layer, and other predetermined processings based on the data supplied from the decoding section 14. Moreover, the data-processing section 15 supplies the data which should be transmitted to other equipments to the encoding section 16. Furthermore, the data-processing section 15 receives the random number supplied from the random-number-generation section 24, and generates NFCID (NFC Identification) as information which specifies the NFC communication device itself from the random number. NFCID generated from the random number supplied from the random-number-generation section 24 is arranged to the polling response frame mentioned later as NFCID which specifies self, and the data-processing section 15 supplies it to the encoding section 16, when NFCID is required by the polling request frame mentioned later from other equipments.

[0037]

The encoding section 16 encodes the data supplied from the data-processing section 15 to a Manchester code etc., and supplies them to the selection section 17. The selection section 17 chooses either the modulation section 19 or the load modulation sections 20, and outputs the signal supplied to the selected one of it from the encoding section 16.

[0038]

Here, the selection section 17 chooses the modulation section 19 or the load modulation section 20 according to control of a control section 21. The communicate mode is the passive mode, and a control section 21 makes the load modulation section 20 choose it as the selection section 17, when the NFC communication device 1 serves as a target. Moreover, a control section 21 makes the modulation section 19 choose it as the selection section 17, when the communicate mode is the active mode, or when the communicate mode is the passive mode and the NFC communication device 1 serves as an initiator. Therefore, although the communicate mode is the passive mode and the signal which the encoding section 16 outputs is supplied to the load modulation section 20 through the selection section 17 in the case where the NFC communication device 1 serves as a target, it is supplied to the modulation section 19 through the selection section 17 in other cases.

[0039]

The electromagnetic wave output section 18 passes the current for making the subcarrier (electromagnetic wave) of a single predetermined frequency emit from an antenna 11 at an antenna 11. The electromagnetic wave output section 18 modulates the modulation section 19 according to the signal to which the subcarrier as a current passed at an antenna 11 is supplied from the selection section 17. Thereby, from an antenna 11, the electromagnetic wave on which the data-processing section 15 modulated the subcarrier according to the data outputted to the encoding section 16 is emitted.

[0040]

The load modulation section 20 changes the impedance when seeing the coil as an antenna 11 from the exterior according to the signal supplied from the selection section 17, and, thereby, performs a load modulation. When other equipments output the electromagnetic wave as a subcarrier, RF field (field) is formed in the perimeter of an antenna 11, and the impedance when seeing the coil as an antenna 11 changes, RF field around an antenna 11 also changes. The subcarrier as an electromagnetic wave which other equipments are outputting is modulated by this according to the signal supplied from the selection section 17, and the data which the data-processing section 15 outputted to the encoding section 16 are transmitted to other equipments which are outputting the electromagnetic wave.

[0041]

Here, as a modulation technique in the modulation section 19 and the load modulation section 20, amplitude modulation (ASK (Amplitude Shift Keying)) is employable, for example. However, it is not limited to ASK and the modulation technique in the modulation section 19 and the load modulation section 20 can adopt PSK (Phase Shift Keying), and QAM (Quadrature Amplitude Modulation) and others. Moreover, what is necessary is not to be limited to numeric values, such as 8% to 30%, 50%, and 100 etc.%, about the modulation factor of the amplitude, and just to choose a suitable thing.

[0042]

A control section 21 controls each block which constitutes the NFC communication device 1. A power supply section 22 supplies a power source required for each block which constitutes the NFC communication device 1. In addition, since drawing

becomes complicated, the illustration showing controlling each block whose control section 21 constitutes the NFC communication device 1 by drawing 4 of a line, and illustration of the line by which a power supply section 22 means supplying a power source in each block which constitutes the NFC communication device 1 have been omitted.

[0043]

A detecting element 23 detects whether the current which flows at an antenna 11 is received like a receive section 12, and the electromagnetic wave more than predetermined level (flux density) is received by the antenna 11 based on the current.

[0044]

The random-number-generation section 24 generates a random number, and supplies it to the data-processing section 15.

[0045]

In the above-mentioned case, in the decoding section 14 and the encoding section 16, the Manchester code adopted by the above-mentioned type C was processed here, but in the decoding section 14 and the encoding section 16, process is able to choose one from two or more kinds of signs, such as not only a Manchester code but modification DOMIRA adopted by Type A, NRZ adopted by Type C, and to make it.

[0046]

Next, drawing 5 shows the example of a configuration of the recovery section 13 of drawing 4 .

[0047]

At drawing 5 , the recovery section 13 consists of the recovery section 321 of N individual which are the 31 or 2 or more selection sections thru/or 32 Ns, and the selection section 33.

[0048]

According to control of a control section 21 ( drawing 4 ), while being the recovery section 321 of N individual thru/or 32Ns, from from, the selection section 31 chooses 32n (n= 1, 2, ..., N) of one recovery section, and supplies the signal which a receive section 12 outputs to 32n of the selected recovery section.

[0049]

32n of recovery sections restores to the signal transmitted at the n-th transmission rate, and they supply it to the selection section 33. Here, 32n of recovery sections and 32n [ of recovery sections ]' (n!=n') restore to the signal transmitted at a different transmission rate. Therefore, the recovery section 13 of drawing 5 can restore now to the signal transmitted at the transmission rate as N of the 1st thru/or ** a Nth. in addition, as a transmission rate as N, it mentioned above, for example -- high-speed 424kbps(es), 848kbps, etc. can be adopted further more 212 kbps 106 kbpses. That is, the transmission rate already adopted in the contiguity communication link of the existing IC card system etc. and the other transmission rate can be included in the transmission rate as N.

[0050]

According to control of a control section 21, while being the recovery section 321 of N individual thru/or 32Ns, from from, the selection section 33 chooses 32n of one recovery section, and supplies the recovery output obtained in 32n of the recovery section to the decoding section 14.

[0051]

A control section 21 ( drawing 4 ) makes the selection section 31 make sequential selection of the recovery section 321 of N individual thru/or the 32 Ns, and, thereby, makes it recover the recovery section 321 thru/or 32Ns of signals supplied through the selection section 31 from a receive section 12 to each in the recovery section 13 constituted as mentioned above. And a control section 21 recognizes 32n of recovery sections which were able to recover normally the signal supplied through the selection section 31 from the receive section 12, and controls the selection section 33 to choose the output of 32n of the recovery section. The selection section 33 chooses 32n of recovery sections according to control of a control section 21, and, thereby, the normal recovery output obtained in 32n of recovery sections is supplied to the decoding section 14.

[0052]

Therefore, in the recovery section 13, it can restore to the signal transmitted at the transmission rate of the arbitration of the transmission rates as N.

[0053]

In addition, only when it is able to get over normally, a recovery output is outputted, nothing is outputted, it can twist (for example, it becomes high impedance), and the recovery section 321 thru/or 32 Ns can be made like, when it is not able to get over normally. In this case, the selection section 33 takes the recovery section 321 thru/or an OR with an outputs [ all ] of 32 Ns, and should just output it to the decoding section 14.

[0054]

Next, drawing 6 shows the example of a configuration of the modulation section 19 of drawing 4 .

[0055]

At drawing 6 , the modulation section 19 consists of the modulation section 421 of N individual which are the 41 or 2 or more selection sections thru/or 42 Ns, and the selection section 43.

[0056]

According to control of a control section 21 ( drawing 4 ), while being the modulation section 421 of N individual thru/or 42Ns, from from, the selection section 41 chooses 42n (n= 1, 2, ..., N) of one modulation section, and supplies the signal which the selection section 17 ( drawing 4 ) outputs to 42n of the selected modulation section.

[0057]

42n of modulation sections is modulated through the selection section 43 according to the signal to which the subcarrier as a current which flows at an antenna 11 is supplied from the selection section 41 so that transmission of data may be performed at the n-th transmission rate. Here, 42n of modulation sections and 42n [ of modulation sections ]' (n!=n') modulate a subcarrier at a different transmission rate. Therefore, the modulation section 19 of drawing 6 can transmit data now at the transmission rate as N of the 1st thru/or ** a Nth. In addition, as a transmission rate as N, the same transmission rate as the ability to restore to the recovery section 13 of drawing 5 is employable, for example.

[0058]

According to control of a control section 21, while being the modulation section 421 of N individual thru/or 42Ns, from from, the selection section 43 chooses the 42n of the same modulation sections as the selection section 41 choosing, and connects electrically 42n of the modulation section, and an antenna 11.

[0059]

A control section 21 ( drawing 4 ) makes the selection section 41 make sequential selection of the modulation section 421 of N individual thru/or the 42 Ns, and, thereby, makes it modulate 42Ns of subcarriers as a current which flow at an antenna 11 through the selection section 43 in the modulation section 19 constituted as mentioned above according to the modulation section 421 thru/or the signal supplied to each from the selection section 41.

[0060]

Therefore, in the modulation section 19, a subcarrier can be modulated and data can be transmitted so that data may be transmitted at the transmission rate of the arbitration of the transmission rates as N.

[0061]

In addition, since it is constituted like the modulation section 19 of drawing 6 , the load modulation section 20 of drawing 4 omits the explanation.

[0062]

As mentioned above, in the NFC communication device 1 thru/or 3, while modulating a subcarrier to the signal of the data to which it is transmitted at the transmission rate of either of the transmission rates as N, it can restore to the signal of the data transmitted at the transmission rate of either of the transmission rates as N. And as mentioned above, the transmission rate already adopted in the contiguity communication link of the existing IC card systems (FeliCa method etc.) etc. and the other transmission rate can be included in the transmission rate as N, for example. Therefore, according to the NFC communication device 1 thru/or 3, between each, data can be exchanged at any transmission rate of the transmission rate as the N. Furthermore, according to the NFC communication device 1 thru/or 3, data can be exchanged at the transmission rate which the IC card and reader/writer have adopted also between the IC cards and reader/writers which constitute the existing IC card system.

[0063]

And even if it, as a result, introduces the NFC communication device 1 thru/or 3 into the service as which the existing contiguity communication link is adopted, a user cannot do derangement etc., therefore the installation can be performed easily. Furthermore, the NFC communication device 1 thru/or 3 can be easily introduced also into the service as which the contiguity communication link by the high-speed data rate it is expected to be to appear in the future is adopted, aiming at coexistence with the existing contiguity communication link.

[0064]

Moreover, in the NFC communication device 1 thru/or 3, since the data transmission in the active mode in which data are transmitted when self besides the passive mode adopted by the conventional contiguity communication link outputs an electromagnetic wave is possible, even if it does not mind other equipments, such as reader/writer, data can be exchanged directly.

[0065]

Next, drawing 7 shows other examples of a configuration of the recovery section 13 of drawing 4 . In addition, about the case in drawing 5 , and the corresponding part, the same sign is attached among drawing, and, below, the explanation is omitted suitably. That is, the recovery section 13 of drawing 7 is fundamentally constituted similarly with the case [ the selection section 31 is not formed and also ] in drawing 5 .

[0066]

That is, to the recovery section 321 thru/or 32 Ns, the signal which a receive section 12 outputs with the gestalt of operation of drawing 7 is supplied to coincidence, and the signal from a receive section 12 restores to it by the recovery section 321 thru/or 32Ns at coincidence. And a control section 21 recognizes 32n of recovery sections which were able to restore to the signal from a receive section 12 normally, and controls the selection section 33 to output 32n of the recovery section. The selection section 33 chooses 32n of recovery sections according to control of a control section 21, and, thereby, the normal recovery output obtained in 32n of recovery sections is supplied to the decoding section 14.

[0067]

In addition, it is necessary to make recovery actuation always perform to the recovery section 321 thru/or 32 Ns with the gestalt of operation of drawing 7 . On the other hand, with the gestalt of operation of drawing 5 , recovery actuation can be made to be able to perform only to what is chosen as the selection section 31 the recovery section 321 thru/or of the 32 Ns, and other things can stop actuation. Therefore, from a viewpoint which saves the power consumption of equipment, the configuration of drawing 5 is more advantageous than drawing 7 . From a viewpoint which obtains a normal recovery output at an early stage on the other hand, the configuration of drawing 7 is more advantageous than drawing 5 .

[0068]

Next, drawing 8 shows the example of a configuration of further others of the recovery section 13 of drawing 4 .

[0069]

At drawing 8 , the recovery section 13 consists of the adjustable rate recovery section 51 and a rate detecting element 52.

[0070]

The adjustable rate recovery section 51 restores to the signal supplied from a receive section 12 as a signal of the transmission rate according to the directions from the rate detecting element 52, and supplies the recovery result to the decoding section 14. The rate detecting element 52 detects the transmission rate of the signal supplied from a receive section 12, and it directs it in the adjustable rate recovery section 51 so that it may restore to the signal of the transmission rate.

[0071]

In the recovery section 51 constituted as mentioned above, the signal which a receive section 12 outputs is supplied to the adjustable rate recovery section 51 and the rate detecting element 52. The rate detecting element 52 is directed in the adjustable rate recovery section 51 so that the transmission rate of the signal supplied from a receive section 12 may detect any of the transmission rates as N of the 1st thru/or ** a Nth they are and may restore to the signal of the transmission rate. And the adjustable rate recovery section 51 restores to the signal supplied from a receive section 12 as a signal of the transmission rate according to the directions from the rate detecting element 52, and supplies the recovery result to the decoding section 14.

[0072]

Next, each of NFC communication device 1 thru/or 3 can become the initiator which outputs an electromagnetic wave first and starts a communication link. Furthermore, in the active mode, the NFC communication device 1 thru/or 3 output an electromagnetic wave in person, when becoming an initiator, or when becoming a target.

[0073]

When two or more [ of them ] output an electromagnetic wave to coincidence, it becomes impossible therefore, to communicate by collision (collision) arising in the condition that the NFC communication device 1 thru/or 3 are close.

[0074]

the NFC communication device 1 thru/or 3 -- only when it does not detect and exist [ whether the electromagnetic wave (RF field to depend) from other equipments exists, and ], each starts the output of an electromagnetic wave and, thereby, prevents collision. [ then, ] Here, in this way, only when it does not detect and exist [ whether the electromagnetic wave from other equipments exists, and ], the processing which starts the output of an electromagnetic wave is called RFCA (RF Collision Avoidance) processing from the purpose of preventing collision.

[0075]

There are two, the initial RFCA processing which the NFC communication device (the NFC communication device 1 thru/or 1 or more [ Drawing 1 / of 3 ]) which is going to serve as an initiator performs first, and the response RFCA processing performed whenever the NFC communication device which starts the output of an electromagnetic wave during a communication link with the active mode tends to carry out the initiation, in RFCA processing. Only when it does not detect and exist [ whether the electromagnetic wave by other equipments exists, and ] before starting the output of an electromagnetic wave even if it is initial RFCA processing and is response RFCA processing, the point of starting the output of an electromagnetic wave is the same. However, by initial RFCA processing and response RFCA processing, since existence of the electromagnetic wave by other equipments is no

longer detected, the time amount to the timing which must start the output of an electromagnetic wave etc. differs.

[0076]

Then, with reference to drawing 9 , initial RFCA processing is explained first.

[0077]

Drawing 9 shows the electromagnetic wave by which an output is started by initial RFCA processing. In addition, in drawing 9 (the same is said of drawing 10 mentioned later), an axis of abscissa expresses time amount and an axis of ordinate expresses the level of the electromagnetic wave which a NFC communication device outputs.

[0078]

The NFC communication device which is going to serve as an initiator is detecting the electromagnetic wave by other equipments, and after only the output to the time amount TIRFG passes [ the electromagnetic wave by other equipments ] by starting the output of an electromagnetic wave when only time amount TIDT+nxTRFW is not detected continuously, it always starts transmission (Send Request) of data (a command is included).

[0079]

Here, TIDT in time amount TIDT+nxTRFW is called initial delay time amount, and if it is expressing the frequency of a subcarrier with fc, an adult value will be adopted from 4096/fc, for example. n is or more 0 three or less integer, and is generated using a random number. TRFW is called RF latency time, for example, 512/fc is adopted. Time amount TIRFG is called an initial guard time, for example, an adult value is adopted from 5ms.

[0080]

In addition, reduction of possibility of starting the output of an electromagnetic wave is achieved to the timing that two or more NFC communication devices are the same, by adopting n which is a random number as time amount TIDT+nxTRFW by which an electromagnetic wave must not be detected.

[0081]

When a NFC communication device starts the output of an electromagnetic wave by initial RFCA processing, the NFC communication device serves as an initiator, but when the active mode is set up as the communicate mode at that time, the NFC communication device used as an initiator suspends the output of an electromagnetic wave, after ending transmission of own data. On the other hand, as the communicate mode, when the passive mode is set up, the NFC communication device used as an initiator continues the output of the electromagnetic wave started by initial RFCA processing as it is until the communication link with a target is completed completely.

[0082]

Next, drawing 10 shows the electromagnetic wave by which an output is started by response RFCA processing.

[0083]

The NFC communication device which is going to output an electromagnetic wave in the active mode detects the electromagnetic wave by other equipments, and after only the output to the time amount TARFG passes [ the electromagnetic wave by other equipments ] by starting the output of an electromagnetic wave when only time amount TADT+nxTRFW is not detected continuously, it starts transmission (Send Responsese) of data.

[0084]

Here, n and TRFW in time amount TADT+nxTRFW are the same as that of the case in initial RFCA processing of drawing 9 . Moreover, TADT in time amount TADT+nxTRFW is called an active delay time, for example, the value below 2559-/fc is adopted more than 768-/fc. Time amount TARFG is called an active guard time, for example, an adult value is adopted from 1024/fc.

[0085]

In order to start the output of an electromagnetic wave by initial RFCA processing so that clearly from drawing 9 and drawing 10 , an electromagnetic wave must not exist between the initial delay time amount TIDT at least, and in order to start the output of an electromagnetic wave by response RFCA processing, an electromagnetic wave must not exist between the active delay times TADT at least.

[0086]

And the condition that an electromagnetic wave does not exist rather than the case where it is going to output an electromagnetic wave during a communication link with the active mode from the initial delay time amount4096/fc when a NFC communication device tends to become an initiator, since the active delay time TADT is a value below 2559-/fc more than 768-/fc to TIDT being an adult value is the long duration need. Conversely, if it says, when a NFC communication device tends to output an electromagnetic wave during a communication link with the active mode, after being in the condition that an electromagnetic wave does not exist from the case where it is going to become an initiator, an electromagnetic wave must be outputted so much for between to a dish. This is based on the following reasons.

[0087]

That is, when NFC communication devices communicate in the active mode, one NFC

communication device outputs an electromagnetic wave in person, transmits data, and suspends the output of an electromagnetic wave after that. And the NFC communication device of another side starts the output of an electromagnetic wave, and data are transmitted. Therefore, in the communication link in the active mode, any NFC communication device may have suspended the output of an electromagnetic wave. for this reason, when a NFC communication device tends to become an initiator, in order to check that the communication link in the active mode is not performed around that NFC communication device, the perimeter of the NFC communication device which is going to become an initiator is enough in other equipments not outputting the electromagnetic wave -- it is necessary to carry out a time amount check

[0088]

On the other hand, in the active mode, as mentioned above, when an initiator outputs an electromagnetic wave, data are transmitted to a target. And a target transmits data to an initiator by starting the output of an electromagnetic wave, after an initiator suspends the output of an electromagnetic wave. Then, after, as for an initiator, a target suspends the output of an electromagnetic wave, by starting the output of an electromagnetic wave, data are transmitted to an initiator and data are hereafter exchanged between an initiator and a target similarly.

[0089]

Therefore, around the initiator which is communicating the active mode, and a target When the NFC communication device which is going to serve as an initiator exists, after one side of the initiators and targets which are communicating the active mode suspends the output of an electromagnetic wave If time amount until another side starts the output of an electromagnetic wave is long, since an electromagnetic wave does not exist in the meantime, the NFC communication device which is going to serve as an initiator starts the output of an electromagnetic wave by initial RFCA processing. In this case, the communication link in the active mode currently performed previously will be barred.

[0090]

For this reason, after being in the condition that an electromagnetic wave does not exist, he is trying to have to output an electromagnetic wave for between to a dish so much in the response RFCA processing performed during the communication link in the active mode.

[0091]

Next, as drawing 9 explained, by initial RFCA processing, the NFC communication device which is going to become an initiator starts the output of an electromagnetic wave, and performs transmission of data after that. Although the NFC communication device which is going to become an initiator is starting the output of an electromagnetic wave, and serves as an initiator and the NFC communication device which exists in the location close to the initiator serves as a target, an initiator must specify the target which exchanges the data, in order to carry out an exchange of a target and data. For this reason, an initiator requires NFCID as information which specifies each target from one or more targets which exist in the location close to that initiator, after starting the output of an electromagnetic wave by initial RFCA processing. And the target which exists in the location close to an initiator transmits NFCID which specifies self to an initiator according to the demand from an initiator.

[0092]

Although an initiator specifies a target and exchanges data between the specified target by NFCID transmitted from a target as mentioned above, the processing whose initiator specifies the target which exists in the perimeter (approaching location) by the NFCID is called SDD (Single Device Detection) processing.

[0093]

Here, in SDD processing, although an initiator requires NFCID of a target, this demand is performed, when an initiator transmits the frame called a polling request frame. If a polling request frame is received, a target will determine own NFCID with a random number, and will transmit the frame called the polling response frame which has arranged the NFCID, for example. An initiator is receiving the polling response frame transmitted from a target, and recognizes NFCID of a target.

[0094]

By the way, when an initiator requires the NFCID from the target of the perimeter and two or more targets exist in the perimeter of an initiator, NFCID may be transmitted to 2, as mentioned above coincidence of two or more of the targets. In this case, NFCID transmitted from those two or more targets cannot carry out collision, and an initiator cannot recognize that NFCID that carried out collision.

[0095]

Then, SDD processing is performed by the approach using a time slot in order to avoid the collision of NFCID if possible.

[0096]

That is, drawing 11 shows the sequence of the SDD processing performed by the approach which used the time slot. In addition, in drawing 11 , five target #1, #2, #3, #4, and #5 shall have existed in the perimeter of an initiator.

[0097]
In SDD processing, although an initiator transmits a polling request frame, only the predetermined time amount Td is set after completion of the transmission, and the time slot of the width of face of the predetermined time amount Ts is prepared. In addition, time amount Td is set to 512x64/fc, and time amount Ts as width of face of a time slot is set to 256x64/fc. Moreover, a time slot is specified by giving the sequential number (integer) from [ from what is preceded most ] 0 to for example, a time amount target.
[0098]
Although four, time-slot #0, #1, #2, and #3, are shown, a time slot can be prepared to predetermined numbers, such as 16, here at drawing 11 . An initiator specifies the number TSN of the time slots prepared to a certain polling request frame, it is included in a polling request frame, and is transmitted to a target.
[0099]
A target receives the polling request frame transmitted from an initiator, and recognizes the number TSN of the time slots arranged at the polling request frame. Furthermore, a target generates the integer R of the range of more than 0TSN-1 with a random number, is the timing of time-slot #R specified for the integer R, and transmits the polling response frame which has arranged own NFCID.
[0100]
As mentioned above, since a target determines the time slot as timing which transmits a polling response frame with a random number, the timing to which two or more targets transmit a polling response frame will vary, and, thereby, it can avoid the collision of the polling response frames which two or more targets transmit as much as possible.
[0101]
In addition, in a target, even if a random number determines the time slot as timing which transmits a polling response frame, the time slot to which two or more targets transmit a polling response frame may be in agreement, and, thereby, the collision of a polling response frame may arise. In time-slot #0, in time-slot #1, the polling response frame of target #2 is transmitted [ in / in the polling response frame of target #1 and #3 / time-slot #3 ] for the polling response frame of target #5, respectively, and the polling response frame of target #1 and #3 has produced [ in / in the polling response frame of target #4 / time-slot #2 ] collision with the gestalt of operation of drawing 11 .
[0102]
In this case, an initiator cannot receive normally the polling response frame of target #1 and #3 which has produced collision. Therefore, again, an initiator transmits a polling request frame and, thereby, requires transmission of the polling response frame by which each NFCID has been arranged from target #1 and #3. target #1 which is in the perimeter in an initiator hereafter thru/or #5 — transmission of the polling request frame by the initiator and transmission of the polling response frame by the target are repeatedly performed until it can recognize all NFCID(s).
[0103]
In addition, when an initiator transmits a polling request frame again, and when [ all target #1 thru/or #5 ] a polling response frame is returned, possibility that polling response frames will start collision is size again. Then, in a target, when a polling request frame is again received so much for time amount as a dish after receiving a polling request frame from an initiator, the polling request can be disregarded, for example. However, since an initiator cannot recognize that NFCID of target #1 and #3 about target #1 which has produced the collision of a polling response to the polling request frame transmitted first with the gestalt of operation of drawing 11 in this case, and #3, an exchange of the data between target #1 or #3 can be performed.
[0104]
Then, a polling response frame is received normally, and an initiator removes temporarily from the candidate for a communication link, and can be prevented from returning the polling response frame as a response to a polling request frame by this about target #2 which have recognized the NFCID, #4, and #5, so that it may mention later. In this case, returning a polling response frame is set only to target #1 which has not recognized NFCID by transmission of the first polling request frame, and #3 to the polling request frame for the second time which an initiator transmits. therefore -- while making small possibility that polling response frames will start collision in this case -- target #1 thru/or #5 -- it becomes possible to recognize all NFCID(s).
[0105]
Moreover, a target will determine own NFCID with a random number here, if a polling request frame is received as mentioned above (generation). For this reason, from a different target, the same NFCID is arranged at a polling response frame, and may be transmitted to an initiator. When the polling response frame by which the same NFCID has been arranged is received, a polling request frame can be made to transmit to an initiator again like the case where for example, polling response frames start collision, in the time slot from which an initiator differs.
[0106]

In addition, in the above-mentioned case, an initiator prepares a time slot on the basis of the timing immediately after transmitting a polling request frame, it is the timing of the time slot, and the target transmitted the polling response frame, but the exchange of the polling request frame between an initiator and a target and a polling response frame can be carried out, without using a time slot. That is, when a polling request frame is received, a target is the timing of arbitration and can transmit a polling response frame. However, it is expected that the case where two or more targets transmit a polling response frame to a coincidence term increases to the polling request frame which an initiator transmits as compared with the case where a time slot is used in this case. And when two or more targets transmit a polling response frame to a coincidence term, since an initiator cannot carry out normal reception of the polling response frame by collision, it needs to broadcast a polling request frame again.

[0107]

Here, as mentioned above, also between the IC cards and reader/writers which constitute the existing IC card system, a NFC communication device is the transmission rate which the IC card and reader/writer have adopted, and can exchange data. Now, when a target is the IC card of the existing IC card system, SDD processing is performed as follows, for example.

[0108]

That is, the IC card an initiator starts the output of an electromagnetic wave by initial RFCA processing, and is [ IC card ] a target acquires a power source from the electromagnetic wave, and starts processing. That is, since a target is the IC card of the existing IC card system in now, the power source for operating is generated from the electromagnetic wave which an initiator outputs.

[0109]

After a target acquires a power source and is in the condition that it can operate, the preparations with which the longest also receives a polling request frame within 2 seconds are made, and it waits to transmit a polling request frame from an initiator, for example.

[0110]

On the other hand, an initiator can transmit a polling request frame regardless of whether the preparation which receives a polling request frame in a target was completed.

[0111]

When the polling request frame from an initiator is received, as mentioned above, a target is the timing of a predetermined time slot and transmits a polling response frame to an initiator. When normal reception of the polling response frame from a target is able to be carried out, an initiator recognizes NFCID of the target, as mentioned above. On the other hand, an initiator can transmit a polling request frame again, when normal reception of the polling response frame from a target is not able to be carried out.

[0112]

In addition, since a target is the IC card of the existing IC card system in now, the power source for operating is generated from the electromagnetic wave which an initiator outputs. For this reason, an initiator continues until the communication link with a target ends completely the output of the electromagnetic wave started by initial RFCA processing.

[0113]

Next, a communication link is performed by the NFC communication device by what (it returns) an initiator transmits a command to a target and a target transmits the response to the command from an initiator for.

[0114]

Then, drawing 12 shows the command which an initiator transmits to a target, and the response which a target transmits to an initiator.

[0115]

In drawing 12 , that the alphabetic character of REQ is described to be after the underbar (_) expresses a command, and that the alphabetic character of RES is described to be after the underbar (_) expresses a response. With the gestalt of operation of drawing 12 , as a command, six kinds, ATR_REQ, WUP_REQ, PSL_REQ, DEP_REQ, DSL_REQ, and RLS_REQ, are prepared, and six kinds, ATR_RES, WUP_RES, PSL_RES, DEP_RES, DSL_RES, and RLS_RES, are prepared like the command also as a response to a command. Since an initiator transmits a command (request) to a target and a target transmits the response corresponding to the command to an initiator as mentioned above, a command is transmitted by the initiator and a response is transmitted with a target.

[0116]

Command ATR_REQ is transmitted to a target, when requiring the attribute of a target, while an initiator tells an own attribute (specification) to a target. Here, as an attribute of an initiator or a target, there is a transmission rate of the data which can transmit and receive the initiator or target etc. In addition, to command ATR_REQ, NFCID which specifies its initiator besides the attribute of an initiator is arranged, and a

target recognizes the attribute and NFCID of an initiator by receiving command ATR_REQ.

[0117]

Response ATR_REQ is transmitted to an initiator as a response to the command ATR_REQ, when a target receives command ATR_REQ. An attribute, NFCID, etc. of a target are arranged at response ATR_REQ.

[0118]

In addition, all the transmission rates of the data which can transmit and receive an initiator and a target can be included in the information on the transmission rate as an attribute arranged at command ATR_REQ or response ATR_REQ. In this case, between an initiator and a target, only by the exchange of command ATR_REQ and response ATR_REQ being performed once, the transmission rate which can transmit and receive a target can be recognized and, as for an initiator, a target can also recognize the transmission rate which can transmit and receive an initiator.

[0119]

Command WUP_REQ is transmitted when an initiator chooses the target which communicates. That is, although a target can be made into a DISEREKUTO (deselect) condition (condition which forbade transmission (response) of the data to an initiator) by transmitting command DSL_REQ mentioned later to a target from an initiator, command WUP_REQ dispels the DISEREKUTO condition, and when making a target into the condition of enabling transmission of the data to an initiator, it is transmitted. In addition, the target specified as command WUP_REQ by NFCID which NFCID of a target which dispels a DISEREKUTO condition is arranged and is arranged at the command WUP_REQ among the targets which received command WUP_REQ dispels a DISEREKUTO condition.

[0120]

Response WUP_RES is transmitted as a response to command WUP_REQ, when the target specified by NFCID arranged at the command WUP_REQ among the targets which received command WUP_REQ dispels a DISEREKUTO condition.

[0121]

Command PSL_REQ is transmitted when an initiator changes the communications parameter about the communication link with a target. Here, as a communications parameter, there is a transmission rate of the data exchanged between an initiator and a target etc., for example.

[0122]

The value of the communications parameter after modification is arranged at command PSL_REQ, and it is transmitted to a target from an initiator. A target receives command PSL_REQ and changes a communications parameter according to the value of the communications parameter arranged there. Furthermore, a target transmits response PSL_RES to command PSL_REQ.

[0123]

The data which command DEP_REQ is transmitted when an initiator transmits and receives data (the so-called live data) (data exchange between targets), and should be transmitted to a target there are arranged. The data which a target should transmit response DEP_RES as a response to command DEP_REQ, and should be transmitted there at an initiator are arranged. Therefore, data are transmitted to a target by command DEP_REQ from an initiator, and data are transmitted to an initiator from a target by response DEP_RES to the command DEP_REQ.

[0124]

Command DSL_REQ is transmitted when an initiator makes a target a DISEREKUTO condition. The target which received command DSL_REQ will transmit response DSL_RES to the command DSL_REQ, will be in a DISEREKUTO condition, and will not react to any commands other than command WUP_REQ henceforth (it stops returning a response).

[0125]

Command RLS_REQ is transmitted when an initiator ends the communication link with a target completely. The target which received command RLS_REQ transmits response RLS_RES to the command RLS_REQ, and ends the communication link with an initiator completely.

[0126]

Here, each of command DSL_REQ and RLS_REQ is common in that a target is released from the object of the communication link with an initiator. However, although the target released by command DSL_REQ will be in an initiator and the condition which can be communicated again by command WUP_REQ, the target released by command RLS_REQ will not be in an initiator and the condition which can be communicated, unless the exchange of the polling request frame mentioned above and a polling response frame is performed between initiators. At this point, command DSL_REQ differs from RLS_REQ.

[0127]

In addition, when transmitting a command to a certain target, an initiator includes in a command NFCID of the target recognized by exchanging a polling request frame and a polling response frame between targets, and transmits. On the other hand, a target

transmits the response to the command to an initiator, when a command is received and NFCID contained in the command is in agreement with own NFCID.

[0128]

Moreover, the exchange of a command and a response can be performed by the transport layer.

[0129]

Next, the communications processing of a NFC communication device is explained with reference to the flow chart of drawing 13 .

[0130]

A NFC communication device judges first whether the electromagnetic wave by other equipments was detected in step S1, when starting a communication link.

[0131]

Here, in a NFC communication device ( drawing 4 ), for example, the control section 21 is supervising the level of the electromagnetic wave (the electromagnetic wave used with a NFC communication device, and electromagnetic wave with the same frequency band etc.) detected by the detecting element 23, and it is judged at step S1 based on the level whether the electromagnetic wave by other equipments was detected.

[0132]

In step S1, when judged with the electromagnetic wave by other equipments not having been detected, it progresses to step S2 and a NFC communication device processes processing of the initiator in the passive mode which sets the communicate mode as the passive mode or the active mode, and mentions it later, or the initiator in the active mode. And a NFC communication device repeats the same processing return and the following to step S1 after termination of the processing.

[0133]

Here, in step S2, the communicate mode of a NFC communication device may be set as any of the passive mode or the active modes, as mentioned above. However, when a target cannot turn into only a target in the passive modes, such as an IC card of the existing IC card system, at step S2, a NFC communication device needs to set the communicate mode as the passive mode, and needs to process the initiator in the passive mode.

[0134]

When it is judged with the electromagnetic wave by other equipments having been detected in step S1 on the other hand (i.e., when the electromagnetic wave by other equipments is detected around a NFC communication device), it progresses to step S3 and a NFC communication device judges whether the electromagnetic wave detected at step S1 is continue being detected.

[0135]

In step S3, when judged with an electromagnetic wave continuing being detected, it progresses to step S4 and a NFC communication device processes the target in the passive mode which sets the communicate mode as the passive mode, and mentions it later. Namely, it is the case which is continuing outputting the electromagnetic wave which started the output by initial RFCA processing by becoming the initiator in the passive mode, and a NFC communication device processes by other equipments with which the case where an electromagnetic wave is continuing being detected approaches for example, a NFC communication device serving as a target in the passive mode. And the same processing is repeated by step S1 return and the following after termination of the processing.

[0136]

Moreover, in step S3, when judged with an electromagnetic wave continuing being detected, it progresses to step S5 and a NFC communication device processes the target in the active mode which sets the communicate mode as the active mode, and mentions it later. That is, since other equipments with which the case where an electromagnetic wave is continuing being detected approaches for example, a NFC communication device are the cases which started the output of an electromagnetic wave by initial RFCA processing by becoming the initiator in the active mode, and suspended the output of the electromagnetic wave after that, they serve as a target in the active mode, and a NFC communication device processes. And the same processing is repeated by step S1 return and the following after termination of the processing.

[0137]

Next, with reference to the flow chart of drawing 14 , processing of the initiator in the passive mode by the NFC communication device is explained.

[0138]

In processing of the initiator in the passive mode, a NFC communication device starts the output of an electromagnetic wave in step S11 first. In addition, in step S1 of above-mentioned drawing 13 , step S11 in processing of the initiator in this passive mode is performed, when an electromagnetic wave is not detected. That is, in step S1 of drawing 13 , a NFC communication device starts the output of an electromagnetic wave in step S11, when an electromagnetic wave is not detected. Therefore, processing of steps S1 and S11 is equivalent to above-mentioned initial RFCA

processing.

[0139]

Then, it progresses to step S12, and a NFC communication device sets the variable n showing a transmission rate to 1 as initial value, and progresses to step S13. At step S13, a NFC communication device is the n-th transmission rate (suitably henceforth the n-th rate), transmits a polling request frame and progresses to step S14. At step S14, from other equipments, a NFC communication device is the n-th rate, and judges whether the polling response frame has been transmitted.

[0140]

When it is judged [ that a polling response frame has not been transmitted and ] from other equipments in step S14, Namely, for example, other equipments close to a NFC communication device cannot perform a communication link at the n-th rate. When the polling response frame to the polling request frame transmitted at the n-th rate does not come on the contrary, or when other equipments do not exist in a perimeter, step S15 thru/or S19 are skipped, and it progresses to step S20.

[0141]

Moreover, when it is judged with the polling response frame having been transmitted at the n-th rate from other equipments in step S14, Namely, for example, other equipments close to a NFC communication device can perform a communication link at the n-th rate. When the polling response frame to the polling request frame transmitted at the n-th rate comes on the contrary, it progresses to step S15 and judges whether the NFC communication device was able to carry out normal reception of the polling response frame from other equipments. When judged with the ability of normal reception of the polling response frame from other equipments to have not been carried out in step S15, Namely, since two or more equipments existed in the perimeter of a NFC communication device and the polling response frame has been transmitted to it by the same time slot from two or more of the equipments, [ for example, ] When collision arises and a NFC communication device is not able to carry out normal reception of the polling response frame, step S16 thru/or S19 are skipped, and it progresses to step S20.

[0142]

When judged with the ability of normal reception of the polling response frame from other equipments to have been carried out in step S15, it progresses to step S16. Moreover, a NFC communication device Other equipments which have returned the polling response frame as a target in the passive mode It judges whether NFCID already memorized at step S17 to which NFCID of the target is recognized by NFCID arranged at the polling response frame, and the NFCID mentions it later is overlapped.

[0143]

In step S16, when it judges that NFCID arranged from other equipments to a polling response frame overlaps already memorized NFCID, step S17 thru/or S19 are skipped, and it progresses to step S20.

[0144]

In step S16, moreover, NFCID arranged from other equipments to a polling response frame When judged with not overlapping already memorized NFCID, it progresses to step S17. A NFC communication device While memorizing as NFCID which specifies the target which is the equipment of other about NFCID arranged from other equipments to a polling response frame, it recognizes that the target can communicate at the n-th rate.

[0145]

Here, if a NFC communication device recognizes that the target can communicate with NFCID of the target in the passive mode at the n-th rate in step S17, the transmission rate between the target is determined as the n-th rate (temporarily), and the target will communicate at the n-th rate, unless a transmission rate is changed by command PSL_REQ.

[0146]

Moreover, NFCID of the target which the NFC communication device memorized at step S17 is eliminated from a NFC communication device, for example, when the communication link with the target is completed completely.

[0147]

Then, it progresses to step S18, and a NFC communication device transmits command DSL_REQ to the target (target in the passive mode) of NFCID memorized at step S17 at the n-th rate, thereby, it is changed into a DISEREKUTO condition and progresses to step S19 so that the target may not answer the polling request frame transmitted henceforth.

[0148]

At step S19, a NFC communication device receives response DSL_RES which the target made a DISEREKUTO condition by the command DSL_REQ returns to command DSL_REQ which transmitted at step S18, and progresses to step S20.

[0149]

In step S20, at step S13, a NFC communication device judges whether predetermined time amount passed, after transmitting a polling request frame at the n-th rate. Here, predetermined time amount in step S20 can be made into zero or more time amount.

[0150]
In step S20, after transmitting a polling request frame at the n-th rate by step S13, when it is still judged with predetermined time amount having not passed, step S14 thru/or processing of S20 are repeated by step S14 return and the following.
[0151]
Here, by repeating step S14 thru/or processing of S20, a NFC communication device can receive the polling response frame transmitted to the timing of a different time slot, as drawing 11 explained.
[0152]
On the other hand, after transmitting a polling request frame at the n-th rate by step S13, when it is judged with predetermined time amount having passed in step S20, it progresses to step S21 and judges whether a NFC communication device is equal to N whose variable n is the maximum. In step S21, when it judges that Variable n is not equal to Maximum N (i.e., when Variable n is under the maximum N), it progresses to step S22, and only 1 increments Variable n and, as for a NFC communication device, step S13 thru/or processing of S22 are repeated by step S13 return and the following in it.
[0153]
Here, while a NFC communication device is a transmission rate as N by repeating step S13 thru/or processing of S22 and transmitting a polling request frame, the polling response frame which comes by each transmission rate on the contrary is received.
[0154]
When it judges that Variable n is equal to Maximum N, on the other hand in step S21, a NFC communication device at the transmission rate as N as N While transmitting a polling request frame, when the polling response frame which comes by each transmission rate on the contrary is received, it progresses to step S23. A NFC communication device It originates in the polling response frame having been transmitted to coincidence from two or more equipments etc. It judges whether there were some which overlap into NFCID of other equipments recognized whether there was any polling response frame which was not able to carry out normal reception at step S16.
[0155]
In step S23, when judged with there having been some which overlap into NFCID of other equipments which it was judged with there having been a polling response frame which was not able to carry out normal reception, or have been recognized at step S16, the same processing is repeated by step S12 return and the following. It retransmits a message to a polling request frame to the equipment which can identify meaning, such as equipment which has transmitted by this the polling response frame in which an initiator was not able to carry out normal reception, and equipment which has transmitted overlapping NFCID, and which was not able to acquire normal NFCID so to speak.
[0156]
When judged with there being nothing that overlaps into NFCID of other equipments which it was judged with on the other hand there being no polling response frame which was not able to carry out normal reception in step S23, and have been recognized at step S16, it progresses to step S24 and a NFC communication device performs the communications processing (communications processing of the initiator in the passive mode) as an initiator in the passive mode. Here, about the communications processing of the initiator in the passive mode, it mentions later.
[0157]
And after the communications processing of the initiator in the passive mode is completed, a NFC communication device progresses to S25 from step S24, suspends the output of the electromagnetic wave which started the output at step S11, and ends processing.
[0158]
Next, with reference to the flow chart of drawing 15 , processing of the target in the passive mode by the NFC communication device is explained.
[0159]
In processing of the target in the passive mode, first, in step S31, a NFC communication device sets the variable n showing a transmission rate to 1 as initial value, and progresses to step S32. At step S32, from other equipments used as the initiator in the passive mode, a NFC communication device is the n-th rate, and judges whether the polling request frame has been transmitted.
[0160]
In step S32, when judged [ that a polling request frame has not been transmitted and ] from the initiator in the passive mode (i.e., when other equipments close to for example, a NFC communication device cannot perform a communication link at the n-th rate and cannot transmit a polling request frame at the n-th rate), it progresses to step S33 and judges whether a NFC communication device is equal to N whose variable n is the maximum. In step S33, when it judges that Variable n is not equal to Maximum N (i.e., when Variable n is under the maximum N), it progresses to step S34, and only 1 increments Variable n and, as for a NFC communication device, step S32

thru/or processing of S34 are repeated by step S32 return and the following in it.

[0161]

Moreover, in step S33, when it judges that Variable n is equal to Maximum N, step S31 thru/or processing of S34 are repeated by step S31 return and the following. That is, step S31 thru/or processing of S34 are repeated here until the polling request frame transmitted in either of the transmission rates as N is receivable from the initiator in the passive mode.

[0162]

And in step S32, when judged with the polling request frame having been transmitted from the initiator in the passive mode (i.e., when a NFC communication device carries out normal reception of the polling request frame of the n-th rate), it progresses to step S35, and with a random number, a NFC communication device generates own NFCID and progresses to step S36 while determining the transmission rate between initiators as the n-th rate. At step S36, a NFC communication device transmits the polling response frame which has arranged own NFCID at the n-th rate, and progresses to step S37.

[0163]

Here, a NFC communication device communicates at the n-th rate, unless modification of a transmission rate is directed by transmitting command PSL_REQ from the initiator in the passive mode at step S36, after transmitting a polling response frame at the n-th rate.

[0164]

At step S37, a NFC communication device repeats the same processing return and the following to step S31, when it judges [ judging whether command DSL_REQ has been transmitted and not having been transmitted from the initiator in the passive mode, and ].

[0165]

That is, in the passive mode, when a target transmits a polling response frame to the polling request frame transmitted from the initiator, fundamentally, an initiator transmits command DSL_REQ to the target, as step S18 of drawing 14 explained. That an initiator does not transmit command DSL_REQ exceptionally so to speak to a target is the case where NFCID arranged at the polling response frame overlaps NFCID of the target which the initiator has already memorized, even if it can carry out normal reception of the case where normal reception of the polling response frame is not able to be carried out by collision, or the polling response frame, as drawing 14 explained. That is, an initiator does not transmit command DSL_REQ which transmits in step S18 of drawing 14 to the target which was not able to acquire NFCID (normal NFCID) discriminable from other targets.

[0166]

Therefore, in step S37, when judged [ that command DSL_REQ has not been transmitted and ], an initiator is the case where normal NFCID of the NFC communication device which is a target is unacquirable. For this reason, in the NFC communication device used as the target in the passive mode, receiving the polling request frame to which S31 retransmits a message from return and the same processing as the case where it mentions above, i.e., an initiator, from step S37, carrying out regeneration of the new NFCID with a random number, and including and retransmitting a message to a polling response frame is repeated.

[0167]

When it is judged with command DSL_REQ having been transmitted from the initiator in the passive mode in step S37 on the other hand (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S38, and a NFC communication device transmits response DSL_REQ to command DSL_REQ, will be in a DISEREKUTO condition, and will progress to step S39.

[0168]

At step S39, a NFC communication device ends processing, after performing the communications processing (communications processing of the target in the passive mode) and completing the communications processing of the target in the passive mode as a target in the passive mode. In addition, about the communications processing of the target in the passive mode, it mentions later.

[0169]

Next, with reference to the flow chart of drawing 16 , processing of the initiator in the active mode by the NFC communication device is explained.

[0170]

In processing of the initiator in the active mode, step S11 of processing of the initiator in the passive mode of drawing 14 thru/or the respectively same processing as the case in S24 are performed in step S51 thru/or S64. However, in processing of the initiator in the passive mode of drawing 14 , a NFC communication device continues outputting an electromagnetic wave until the processing is completed, but in processing of the initiator in the active mode, only when a NFC communication device transmits data, the points which output an electromagnetic wave differ.

[0171]

That is, in step S51, a NFC communication device starts the output of an

electromagnetic wave.
In addition, in step S1 of above-mentioned drawing 13 , step S51 in processing of the initiator in this active mode is performed, when an electromagnetic wave is not detected. That is, in step S1 of drawing 13 , a NFC communication device starts the output of an electromagnetic wave in step S51, when an electromagnetic wave is not detected. Therefore, processing of steps S1 and S51 is equivalent to above-mentioned initial RFCA processing.
[0172]
Then, it progresses to step S52, and a NFC communication device sets the variable n showing a transmission rate to 1 as initial value, and progresses to step S53. At step S53, a NFC communication device is the n-th rate, it transmits a polling request frame, suspends the output of an electromagnetic wave (it is said suitably that RF off processing is performed hereafter), and progresses to step S54.
[0173]
Here, at step S53, a NFC communication device starts the output of an electromagnetic wave by above-mentioned active RFCA processing, before transmitting a polling request frame. However, in processing of the initiator in the active mode of drawing 16 , when processing of step S53 is performed first, since the output of an electromagnetic wave is already started by the initial RFCA processing corresponding to step S1 of drawing 13 , and processing of drawing 16 of S51, it is not necessary by it to perform active RFCA processing.
[0174]
At step S54, from other equipments, a NFC communication device is the n-th rate, and judges whether the polling response frame has been transmitted.
[0175]
When it is judged [ that a polling response frame has not been transmitted and ] from other equipments in step S54, Namely, for example, other equipments close to a NFC communication device cannot perform a communication link at the n-th rate. Or since other equipments do not exist near the NFC communication device, when the polling response frame to the polling request frame transmitted at the n-th rate does not come on the contrary, step S55 thru/or S59 are skipped, and it progresses to step S60.
[0176]
Moreover, when it is judged with the polling response frame having been transmitted at the n-th rate from other equipments in step S54, Namely, for example, other equipments close to a NFC communication device can perform a communication link at the n-th rate. When the polling response frame to the polling request frame transmitted at the n-th rate comes on the contrary, it progresses to step S55 and judges whether the NFC communication device was able to carry out normal reception of the polling response frame from other equipments. When judged with the ability of normal reception of the polling response frame from other equipments to have not been carried out in step S55, Namely, since two or more equipments existed in the perimeter of a NFC communication device and the polling response frame has been transmitted to it by the same time slot from two or more of the equipments, [ for example, ] When collision arises and a NFC communication device is not able to carry out normal reception of the polling response frame, step S56 thru/or S59 are skipped, and it progresses to step S60.
[0177]
When judged with the ability of normal reception of the polling response frame from other equipments to have been carried out in step S55, it progresses to step S56. Moreover, a NFC communication device Other equipments which have returned the polling response frame as a target in the active mode It judges whether NFCID already memorized at step S57 to which NFCID of the target is recognized by NFCID arranged at the polling response frame, and the NFCID already mentions it later is overlapped.
[0178]
In step S56, when it judges that NFCID arranged from other equipments to a polling response frame overlaps already memorized NFCID, step S57 thru/or S59 are skipped, and it progresses to step S60.
[0179]
In step S56, moreover, NFCID arranged from other equipments to a polling response frame When judged with not overlapping already memorized NFCID, it progresses to step S57. A NFC communication device While memorizing as NFCID which specifies the target which is the equipment of other about NFCID arranged from other equipments to a polling response frame, it recognizes that the target can communicate at the n-th rate.
[0180]
Here, if a NFC communication device recognizes that the target can communicate with NFCID of the target in the active mode at the n-th rate in step S57, the transmission rate between the target is determined as the n-th rate, and the target will communicate at the n-th rate, unless a transmission rate is changed by command PSL_REQ.
[0181]

Moreover, NFCID of the target which the NFC communication device memorized at step S57 is eliminated from a NFC communication device, for example, when the communication link with the target is completed completely.

[0182]

Then, it progresses to step S58, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits command DSL_REQ to the target (target in the active mode) of NFCID memorized at step S55 at the n-th rate.

Thereby, the target will be in the DISEREKUTO condition which does not answer the polling request frame transmitted henceforth. Then, a NFC communication device performs RF off processing, and progresses to S59 from step S58.

[0183]

At step S59, a NFC communication device receives response DSL_RES which the target made a DISEREKUTO condition by the command DSL_REQ returns to command DSL_REQ which transmitted at step S58, and progresses to step S60.

[0184]

In step S60, at step S53, a NFC communication device judges whether predetermined time amount passed, after transmitting a polling request frame at the n-th rate.

[0185]

In step S60, after transmitting a polling request frame at the n-th rate by step S53, when it is still judged with predetermined time amount having not passed, step S54 thru/or processing of S60 are repeated by step S54 return and the following.

[0186]

On the other hand, after transmitting a polling request frame at the n-th rate by step S53, when it is judged with predetermined time amount having passed in step S60, it progresses to step S61 and judges whether a NFC communication device is equal to N whose variable n is the maximum. In step S61, when it judges that Variable n is not equal to Maximum N (i.e., when Variable n is under the maximum N), it progresses to step S62, and only 1 increments Variable n and, as for a NFC communication device, step S53 thru/or processing of S62 are repeated by step S53 return and the following in it.

[0187]

Here, while a NFC communication device is a transmission rate as N by repeating step S53 thru/or processing of S62 and transmitting a polling request frame, the polling response frame which comes by each transmission rate on the contrary is received.

[0188]

When it judges that Variable n is equal to Maximum N, on the other hand in step S61, a NFC communication device at the transmission rate as N as N While transmitting a polling request frame, when the polling response frame which comes by each transmission rate on the contrary is received, it progresses to step S63. A NFC communication device It originates in the polling response frame having been transmitted to coincidence from two or more equipments etc. It judges whether there were some which overlap into NFCID of other equipments recognized whether there was any polling response frame which was not able to carry out normal reception at step S56.

[0189]

In step S63, when judged with there having been some which overlap into NFCID of other equipments which it was judged with there having been a polling response frame which was not able to carry out normal reception, or have been recognized at step S56, the same processing is repeated by step S52 return and the following. It retransmits a message to a polling request frame to the equipment which has transmitted by this the polling response frame in which an initiator was not able to carry out normal reception, and the equipment which has transmitted overlapping NFCID.

[0190]

When judged with there being nothing that overlaps into NFCID of other equipments which it was judged with on the other hand there being no polling response frame which was not able to carry out normal reception in step S63, and have been recognized at step S56, it progresses to step S64, and as an initiator in the active mode, a NFC communication device performs the communications processing (communications processing of the initiator in the active mode), and ends processing after that. Here, about the communications processing of the initiator in the active mode, it mentions later.

[0191]

Next, with reference to the flow chart of drawing 17 , processing of the target in the active mode by the NFC communication device is explained.

[0192]

In processing of the target in the active mode, step S31 of processing of the target in the passive mode of drawing 15 thru/or the respectively same processing as the case in S39 are performed in step S71 thru/or S79. However, although data are transmitted in processing of the target in the passive mode of drawing 15 when a NFC communication device carries out the load modulation of the electromagnetic wave

which the initiator in the passive mode outputs, it differs in processing of the target in the active mode in that a NFC communication device outputs an electromagnetic wave in person, and data are transmitted.

[0193]

That is, in processing of the target in the active mode, step S31 of drawing 15 thru/or the respectively same processing as the case in S35 are performed in step S71 thru/or S75.

[0194]

And it progresses to step S76 after processing of step S75, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits the polling response frame which has arranged own NFCID at the n-th rate. Furthermore, at step S76, a NFC communication device performs RF OFF processing, and progresses to step S77.

[0195]

Here, a NFC communication device communicates at the n-th rate, unless modification of a transmission rate is directed by transmitting command PSL_REQ from the initiator in the active mode at step S76, after transmitting a polling response frame at the n-th rate.

[0196]

At step S77, a NFC communication device repeats the same processing return and the following to step S71, when it judges [ judging whether command DSL_REQ has been transmitted and not having been transmitted from the initiator in the active mode, and ].

[0197]

That is, in the active mode, when a target transmits a polling response frame to the polling request frame transmitted from the initiator, fundamentally, an initiator transmits command DSL_REQ to the target, as step S58 of drawing 16 explained. That an initiator does not transmit command DSL_REQ exceptionally so to speak to a target is the case where NFCID arranged at the polling response frame overlaps NFCID of the target which the initiator has already memorized, even if it can carry out normal reception of the case where normal reception of the polling response frame is not able to be carried out by collision, or the polling response frame, as drawing 16 explained. That is, an initiator does not transmit command DSL_REQ which transmits in step S58 of drawing 16 to the target which was not able to acquire NFCID (normal NFCID) discriminable from other targets.

[0198]

Therefore, in step S77, when judged [ that command DSL_REQ has not been transmitted and ], an initiator is the case where normal NFCID of the NFC communication device which is a target is unacquirable. For this reason, in the NFC communication device used as the target in the active mode, receiving the polling request frame to which S71 retransmits a message from return and the same processing as the case where it mentions above, i.e., an initiator, from step S77, carrying out regeneration of the new NFCID with a random number, and including and retransmitting a message to a polling response frame is repeated.

[0199]

When it is judged with command DSL_REQ having been transmitted from the initiator in the passive mode in step S77 on the other hand (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S78, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits response DSL_REQ to command DSL_REQ. Furthermore, at step S78, a NFC communication device performs RF OFF processing, will be in a DISEREKUTO condition, and will progress to step S79.

[0200]

At step S79, a NFC communication device ends processing, after performing the communications processing (communications processing of the target in the active mode) and completing the communications processing of the target in the active mode as a target in the active mode. In addition, about the communications processing of the target in the active mode, it mentions later.

[0201]

Next, with reference to the flow chart of drawing 18 and drawing 19 , the communications processing of the initiator in the passive mode in step S24 of drawing 14 is explained.

[0202]

In step S91, the NFC communication device which is the initiator in the passive mode chooses the equipment (suitably henceforth attention equipment) which communicates from the targets which memorized NFCID at step S15 of drawing 14 , and progresses to step S92. At step S92, command WUP_REQ is transmitted to attention equipment and this cancels the DISEREKUTO condition of the attention equipment made into the DISEREKUTO condition by transmitting command DSL_REQ at step S19 of drawing 14 (it is suitably said for the Wake rise that it carries out hereafter).

[0203]

Then, attention equipment waits to transmit response WUP_RES to command WUP_REQ, and progresses to S93 from step S92, and a NFC communication device receives the response WUP_RES, and progresses to step S94. At step S94, a NFC communication device transmits command ATR_REQ to attention equipment. And attention equipment waits to transmit response ATR_RES to command ATR_REQ, and progresses to S95 from step S94, and a NFC communication device receives the response ATR_RES.

[0204]

Here, a NFC communication device and attention equipment recognize mutually the transmission rate with which a partner can communicate because a NFC communication device and attention equipment exchange command ATR_REQ by which an attribute is arranged as mentioned above, and response ATR_RES.

[0205]

Then, it progresses to S96 from step S95, and a NFC communication device transmits command DSL_REQ to attention equipment, and changes attention equipment into a DISEREKUTO condition. And attention equipment waits to transmit response DSL_RES to command DSL_REQ, and progresses to S97 from step S96, and a NFC communication device receives the response DSL_RES, and progresses to step S98.

[0206]

At step S98, it judges whether the NFC communication device chose all the targets that memorized NFCID at step S17 of drawing 14 as attention equipment at step S91. In step S98, when a NFC communication device judges with there being a target which has not been chosen as attention equipment yet, to step S91, return and a NFC communication device are newly [ one ] of the targets which have not been chosen as attention equipment chosen as attention equipment, and still repeat the same processing hereafter.

[0207]

In step S98, a NFC communication device moreover, all the targets that memorized NFCID at step S17 of drawing 14 When it judges with having chosen as attention equipment at step S91, a NFC communication device among all the targets that memorized NFCID Command ATR_REQ and response ATR_RES are exchanged. By this When the transmission rate with which each target can communicate has been recognized, it progresses to step S99. A NFC communication device The equipment (attention equipment) which communicates is chosen from the targets which exchanged command ATR_REQ and response ATR_RES at steps S94 and S95, and it progresses to step S100.

[0208]

At step S100, a NFC communication device transmits command WUP_REQ to attention equipment, and, thereby, carries out the Wake rise of the attention equipment made into the DISEREKUTO condition by transmitting command DSL_REQ at step S96. And attention equipment waits to transmit response WUP_RES to command WUP_REQ, and progresses to S101 from step S100, and a NFC communication device receives the response WUP_RES, and progresses to step S111 of drawing 19 .

[0209]

At step S111, a NFC communication device judges whether communications parameters, such as a transmission rate at the time of performing a communication link with attention equipment, are changed.

[0210]

Here, at step S95 of drawing 18 , the NFC communication device has received response ATR_RES from attention equipment, and recognizes communications parameters, such as a transmission rate with which attention equipment can communicate, based on the attribute arranged at the response ATR_RES. A NFC communication device judges with changing a communications parameter in step S111 between for example, attention equipment, that a transmission rate should be changed into a more nearly high-speed transmission rate, when it can communicate at a high-speed transmission rate rather than a current transmission rate. Moreover, when current communication environment is an environment where a noise level is high, in order to fall a transmission error that a NFC communication device can communicate at a low-speed transmission rate rather than a current transmission rate between for example, attention equipment, in step S111, it judges with changing a communications parameter that a transmission rate should be changed into a low speed transmission rate. In addition, even if it is the case which can communicate at a different transmission rate from a current transmission rate between a NFC communication device and attention equipment, it is possible to continue a communication link with a current transmission rate.

[0211]

In step S111, when judged with not changing the communications parameter at the time of performing a communication link with attention equipment (i.e., when continuing a communication link between a NFC communication device and attention equipment with current communications parameters, such as a current transmission rate), step S112 thru/or S114 are skipped, and it progresses to step S115.

[0212]
Moreover, in step S111, when judged with changing the communications parameter at the time of performing a communication link with attention equipment, it progresses to step S112, and a NFC communication device arranges the value of the communications parameter after the modification to command PSL_REQ, and transmits it to attention equipment. And attention equipment waits to transmit response PSL_RES to command PSL_REQ, and progresses to S113 from step S112, and a NFC communication device receives the response PSL_RES, and progresses to step S114.
[0213]
A NFC communication device is changed into the value of the communications parameter which has arranged communications parameters, such as a transmission rate at the time of performing the communication link with attention equipment, to command PSL_REQ which transmitted at step S112 at step S114. A NFC communication device performs the communication link with attention equipment according to communications parameters, such as a transmission rate of the value changed at step S114, unless the exchange of command PSL_REQ and response PSL_RES is henceforth carried out again between attention equipment.
[0214]
In addition, according to the exchange (negotiation) of command PSL_REQ and response PSL_RES, it is possible to also make a change of encoding methods other than [ 16 (decoding section 14) ] a transmission rate (for example, the encoding section of drawing 4 ), the modulation technique of the modulation section 19 and the load modulation section 20 (recovery section 13), etc.
[0215]
Then, it progresses to step S115, and when it judges whether there are any data which should be transmitted and received between attention equipment and is judged with there being nothing, a NFC communication device skips steps S116 and S117, and progresses to step S118.
[0216]
Moreover, in step S115, when judged with there being data which should be transmitted and received between attention equipment, it progresses to step S116 and a NFC communication device transmits command DEP_REQ to attention equipment. Here, at step S116, when there are data which should be transmitted to attention equipment, a NFC communication device arranges the data to command DEP_REQ, and is transmitted.
[0217]
And attention equipment waits to transmit response DEP_RES to command DEP_REQ, and progresses to S117 from step S116, and a NFC communication device receives the response DEP_RES, and progresses to step S118.
[0218]
As mentioned above, the so-called transmission and reception of live data are performed by exchanging command DEP_REQ and response DEP_RES between a NFC communication device and attention equipment.
[0219]
At step S118, a NFC communication device judges whether a communications partner is changed. In step S118, when judged with not changing a communications partner (i.e., when there are still data exchanged between attention equipment for example), the same processing is repeated by step S111 return and the following.
[0220]
Moreover, in step S118, when judged with changing a communications partner (i.e., although there are no data exchanged between for example, attention equipment, when there are data exchanged with other communications partners), it progresses to step S119 and a NFC communication device transmits command DSL_REQ or RLS_REQ to attention equipment. And attention equipment waits to transmit response DSL_RES or RLS_RES to command DSL_REQ or RLS_REQ, and progresses to S120 from step S119, and a NFC communication device receives the response DSL_RES or RLS_RES.
[0221]
Here, as mentioned above, when a NFC communication device transmits command DSL_REQ or RLS_REQ to attention equipment, the target as the attention equipment is released from the object of the communication link with the NFC communication device as an initiator. However, although the target released by command DSL_REQ will be in an initiator and the condition which can be communicated again by command WUP_UP, the target released by command RLS_REQ will not be in an initiator and the condition which can be communicated, unless the exchange of the polling request frame mentioned above and a polling response frame is performed between initiators.
[0222]
In addition, as a case where a certain target is released from the object of the communication link with an initiator, others, for example, an initiator, and a target in case command DSL_REQ or RLS_REQ is transmitted from an initiator to a target separate too much, and there is a case where it becomes impossible to perform a

contiguity communication link, as mentioned above. In this case, like the target released by command RLS_REQ, between a target and an initiator, unless the exchange of a polling request frame and a polling response frame is performed, it will not be in an initiator and the condition which can be communicated.

[0223]

Here, hereafter, suitably, between a target and an initiator, if the exchange of a polling request frame and a polling response frame is not performed, release of the target an initiator and whose communication link are not attained will be called full release. Moreover, release of the target an initiator and whose communication link are attained again is called release by transmitting command WUP_UP from an initiator temporarily.

[0224]

After processing of step S120 progresses to step S121, and a NFC communication device judges whether full release of all the targets that memorized NFCID at step S17 of drawing 14 was carried out. In step S121, when judged with full release of all the targets that memorized NFCID not being carried out yet, to step 99 of drawing 18 , return and a NFC communication device newly choose attention equipment, and repeat the same processing hereafter out of the target by which full release is not carried out, i.e., the target released temporarily.

[0225]

Moreover, in step S121, when judged with full release of all the targets that memorized NFCID having been carried out, processing is ended.

[0226]

In addition, in steps S116 and S117 of drawing 19 , although transmission and reception (data exchange) of data are performed between a target and an initiator by exchanging command DEP_REQ and response DEP_RES, the exchange of this command DEL_REQ and response DEP_RES is one transaction. Through steps S118, S111, S112, and S113, after processing of steps S116 and S117 can be returned to step S114, and can change a communications parameter. Therefore, communications parameters, such as a transmission rate about the communication link between a target and an initiator, can be changed for every transaction.

[0227]

Moreover, in steps S112 and S113, it is possible by exchanging command PSL_REQ and response PSL_RES between an initiator and a target to change the communicate mode of the initiator which is one of the communications parameters, and a target at step S114. Therefore, the communicate mode of a target and an initiator can be changed for every transaction. In addition, this means that the communicate mode of a target and an initiator must not be changed between one transaction.

[0228]

Next, with reference to the flow chart of drawing 20 , the communications processing of the target in the passive mode in step S39 of drawing 15 is explained.

[0229]

In steps S37 and S38 of drawing 15 , since the NFC communication device which is the target in the passive mode is considering the exchange of response DSL_RES as command DSL_REQ between the initiators in the passive mode, it is in the DISEREKUTO condition.

[0230]

Then, in step S131, a NFC communication device is considered as as [ return and a DISEREKUTO condition ] at step S131, when it judges whether command WUP_REQ has been transmitted from the initiator and it is judged [ not having been transmitted and ].

[0231]

Moreover, in step S131, when judged with command WUP_REQ having been transmitted from the initiator (i.e., when a NFC communication device receives command WUP_REQ), it progresses to step S131, and a NFC communication device transmits response WUP_RES to command WUP_REQ, carries out the Wake rise, and progresses to step S133.

[0232]

At step S133, command ATR_REQ judges whether it has been transmitted from the initiator, and when it judges [ not having been transmitted and ], a NFC communication device skips step S134, and progresses to step S135.

[0233]

Moreover, in step S133, when judged with command ATR_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command ATR_REQ), it progresses to step S135, and a NFC communication device transmits response ATR_RES to command ATR_REQ, and progresses to step S135.

[0234]

At step S135, a NFC communication device judges whether command DSL_REQ has been transmitted from the initiator. In step S135, when judged with command DSL_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S136, and a NFC communication device transmits response DSL_RES to command DSL_REQ, and returns to step S131. Thereby, a NFC communication device will be in a DISEREKUTO

condition.

[0235]

On the other hand, when it is judged [ that command DSL_REQ has not been transmitted and ] from an initiator in step S135, it progresses to step S137, and a NFC communication device judges whether command PSL_REQ has been transmitted from the initiator, when it judges [ not having been transmitted and ], it skips steps S138 and S139, and progresses to step S140.

[0236]

Moreover, in step S137, when judged with command PSL_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command PSL_REQ), it progresses to step S138, and a NFC communication device transmits response PSL_RES to command PSL_REQ, and progresses to step S139. At step S139, according to command PSL_REQ from an initiator, a NFC communication device changes the communications parameter, and progresses to step S140.

[0237]

At step S140, when it judges [ judging whether command DEP_REQ has been transmitted and not having been transmitted from an initiator, and ], a NFC communication device skips step S141, and progresses to step S142.

[0238]

Moreover, in step S140, when judged with command DEP_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command DEP_REQ), it progresses to step S141, and a NFC communication device transmits response DEP_RES to command DEP_REQ, and progresses to step S142.

[0239]

At step S142, when it judges [ that a NFC communication device judges whether command RSL_REQ has been transmitted, and has not been transmitted from an initiator, and ], the same processing is repeated by step S133 return and the following.

[0240]

Moreover, in step S142, when judged with command RSL_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command RSL_REQ), it progresses to step S143, and a NFC communication device transmits response RSL_RES to command RSL_REQ, thereby, it ends the communication link with an initiator completely, and ends processing.

[0241]

Next, drawing 21 and drawing 22 are flow charts which show the detail of the communications processing of the initiator in the active mode in step S64 of drawing 16 .

[0242]

In addition, by the communications processing of the initiator in the passive mode explained by drawing 18 and drawing 19 , although an initiator is continuing outputting an electromagnetic wave, by the communications processing of the initiator in the active mode of drawing 21 and drawing 22 , by performing active RFCA processing, before transmitting a command, an initiator starts the output of an electromagnetic wave and performs processing (OFF processing) which suspends the output of the electromagnetic wave after termination of transmission of a command. If this point is removed, since the step step S91 of drawing 18 step S111 of S101 and drawing 19 thru/or the respectively same processing as the case in S121 are performed, by the communications processing of the initiator in the active mode of drawing 21 , the explanation will be omitted in step S151 step S171 of S161 and drawing 22 thru/or S181.

[0243]

Next, drawing 23 is a flow chart which shows the detail of the communications processing of the target in the active mode in step S79 of drawing 17 .

[0244]

In addition, although data are transmitted in the communications processing of the target in the passive mode explained by drawing 20 when a target carries out the load modulation of the electromagnetic wave which the initiator is outputting In the communications processing of the target in the active mode of drawing 23 , a target starts the output of an electromagnetic wave by performing active RFCA processing, before transmitting a command, and performs processing (OFF processing) which suspends the output of the electromagnetic wave after termination of transmission of a command. If this point is removed, since step S131 of drawing 20 thru/or the respectively same processing as the case in S143 are performed, by the communications processing of the target in the active mode of drawing 23 , the explanation will be omitted in step S191 thru/or S203.

[0245]

As mentioned above, in an initiator, NFCID arranged at the polling response frame which the polling request frame which requires NFCID which identifies a target is transmitted, and a target transmits as a response to the polling request frame is acquired. And in an initiator, when NFCID of a target is not able to be acquired normally, it retransmits a message to a polling request frame. On the other hand, if the polling response frame from an initiator is received, a target will generate own NFCID

with a random number, will arrange it to a polling response frame, and will be transmitted to an initiator. Furthermore, when a polling request frame is re-received from an initiator, a target carries out regeneration of the own NFCID with a random number, arranges it to a polling response frame, and is broadcast again to an initiator.

[0246]

Therefore, when two or more targets are close to the perimeter of an initiator, about each of two or more of the targets, an initiator can acquire unique NFCID and can identify two or more targets of each certainly by the NFCID. Consequently, it can prevent that a response is transmitted to coincidence from two or more targets to the command which the initiator transmitted to certain addressing to NFCID.

[0247]

Moreover, since the random number generated NFCID, it is not necessary to prepare in equipment EEPROM for memorizing the NFCID which is needed when the unique number of immobilization etc. is set to NFCID, and enables manufacture etc. to carry out equipment by low cost.

[0248]

In addition, it is not necessary to necessarily process the processing step explaining the processing which a NFC communication device performs to time series in accordance with the sequence indicated as a flow chart, and it is a juxtaposition thing also including the processing (for example, parallel processing or processing by the object) performed according to an individual in this specification.

[0249]

Moreover, after an initiator acquires NFCID of all the targets in the approaching location with the gestalt of this operation, Although the Wake rise only of the attention equipment is carried out from a DISEREKUTO condition and other targets were kept carried out in the DISEREKUTO condition when communicating by using a certain target as attention equipment After acquiring NFCID of all the targets in the approaching location, it is possible for it to be made to communicate by carrying out the Wake rise of all those targets. In this case, it is recognized by NFCID arranged at that command whether the command which an initiator transmits is a thing to which target. That is, the target of NFCID arranged at the command will receive the command which the initiator transmitted, and the response to the command will be returned to a target.

[0250]

Furthermore, although the gestalt of this operation explained the case where this invention was applied to the NFC communication device which can transmit and receive the data in two or more transmission rates, in addition to this, this invention is applicable to the communication device which can only transmit and receive the data in a certain single transmission rate. Furthermore, this invention is applicable also to the communication device which communicates only with either the passive mode or the active modes.

[0251]

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[Translation done.]



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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the example of a configuration of the gestalt of 1 operation of the communication system which applied this invention.

[Drawing 2] It is drawing explaining the passive mode.

[Drawing 3] It is drawing explaining the active mode.

[Drawing 4] It is the block diagram showing the example of a configuration of the NFC communication device 1.

[Drawing 5] It is the block diagram showing the example of a configuration of the recovery section 13.

[Drawing 6] It is the block diagram showing the example of a configuration of the modulation section 19.

[Drawing 7] It is the block diagram showing other examples of a configuration of the recovery section 13.

[Drawing 8] It is the block diagram showing the example of a configuration of further

others of the recovery section 13.

[Drawing 9] It is a timing chart explaining initial RFCA processing.

[Drawing 10] It is a timing chart explaining active RFCA processing.

[Drawing 11] It is drawing explaining SDD processing.

[Drawing 12] It is drawing showing the list of a command and responses.

[Drawing 13] It is a flow chart explaining processing of a NFC communication device.

[Drawing 14] It is the flow chart which shows processing of the initiator in the passive mode.

[Drawing 15] It is the flow chart which shows processing of the target in the passive mode.

[Drawing 16] It is the flow chart which shows processing of the initiator in the active mode.

[Drawing 17] It is the flow chart which shows processing of the target in the active mode.

[Drawing 18] It is the flow chart which shows the communications processing of the initiator in the passive mode.

[Drawing 19] It is the flow chart which shows the communications processing of the initiator in the passive mode.

[Drawing 20] It is the flow chart which shows the communications processing of the target in the passive mode.

[Drawing 21] It is the flow chart which shows the communications processing of the initiator in the active mode.

[Drawing 22] It is the flow chart which shows the communications processing of the initiator in the active mode.

[Drawing 23] It is the flow chart which shows the communications processing of the target in the active mode.

[Description of Notations]

1 thru/or 3 NFC communication device 11 An antenna, 12 Receive section 13 The recovery section, 14 Decoding section 15 The data-processing section, 16 Encoding section 17 The selection section, 18 Electromagnetic wave output section 19 The modulation section, 20 Load modulation section 21 A control section, 22 Power supply section 23 Detecting element 24 Random-number-generation section 31 selection sections 321 thru/or 32Ns Recovery section 33 41 Selection section 421 thru/or 42Ns Modulation section 43 Selection section 51 The adjustable rate recovery section and 52 Rate detecting element

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[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.

3.In the drawings, any words are not translated.

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DRAWINGS

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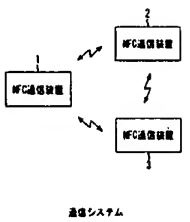
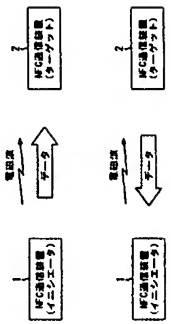
[Drawing 1]

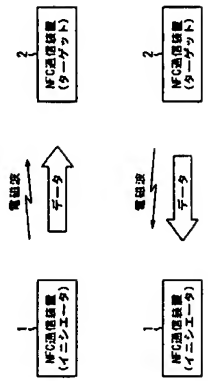


[Drawing 2]



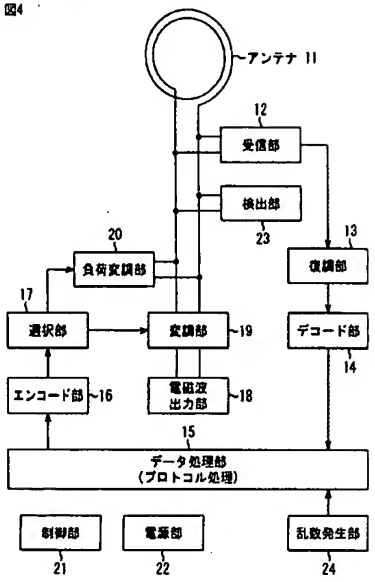
[Drawing 3]

図3



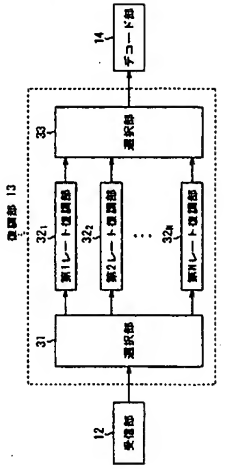

[Drawing 4]

図4



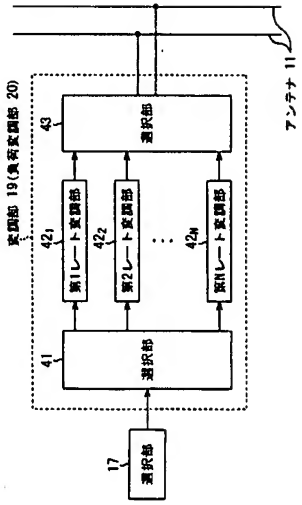

[Drawing 5]

図5



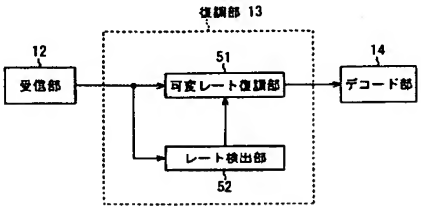

[Drawing 6]

図6



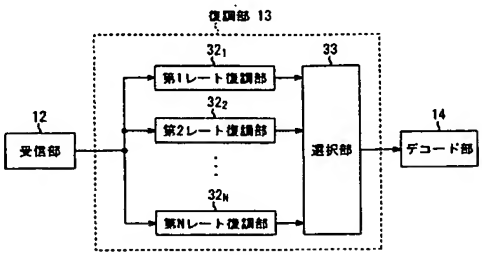
[Drawing 8]

図8



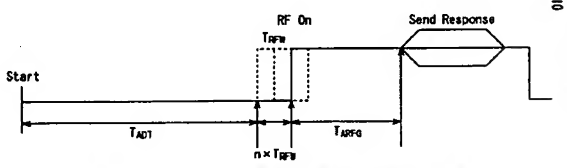

[Drawing 7]

図7




[Drawing 10]

図10




Response RF Collision Avoidance sequence during activation

$T_{ADT}$: Active delay time, sense time between RF off Initiator/Target and Target/Initiator. (768/fc≤$T_{ADT}$≤2 559/fc)

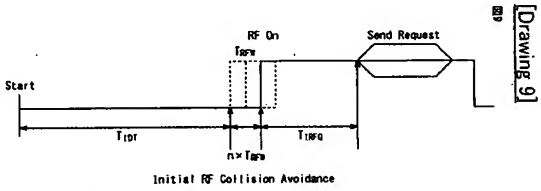
$T_{RFW}$: RF waiting time, (512/fc)

n: Randomly generated number of Time Periods for $T_{RFW}$. (0 ≤ n ≤ 3)

$T_{ARFG}$: Active guard time between switching on RF field and start to send command. ($T_{ARFG}$ >1024/fc)

[Drawing 9]

図9




Initial RF Collision Avoidance

$T_{IDT}$: Initial delay time. $T_{IDT}$>4 096/fc

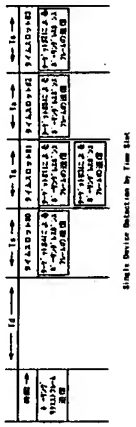
$T_{RFW}$: RF waiting time, 512/fc

n: randomly generated number of Time Periods for $T_{RFW}$. 0≤n≤3

$T_{IRFG}$: Initial guard-time between switching on RF field and start to send command or data frame. $T_{IRFG}$>5 ms

[Drawing 11]

図11



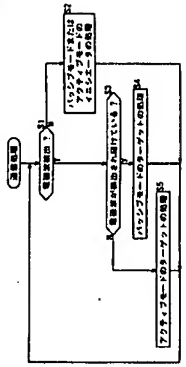
[Drawing 12]

図12

| コマンド/レスポンス |
|---|
| ATR_REQ |
| ATR_RES |
| WUP_REQ |
| WUP_RES |
| PSL_REQ |
| PSL_RES |
| DEP_REQ |
| DEP_RES |
| DSL_REQ |
| DSL_RES |
| RLS_REQ |
| RLS_RES |

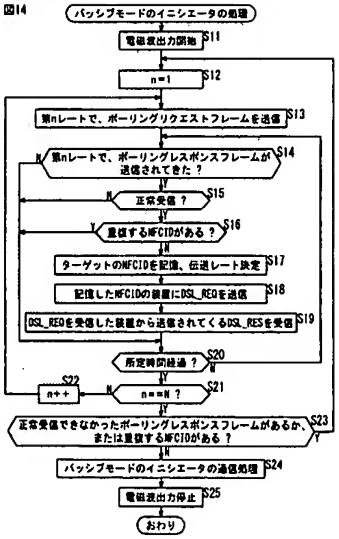
[Drawing 13]

図13



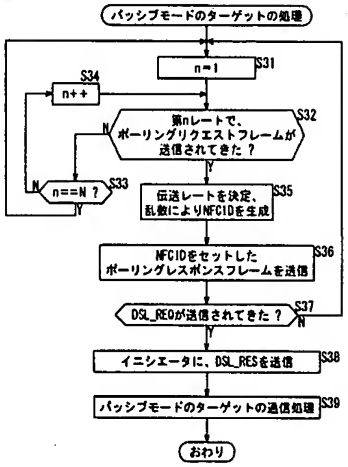
[Drawing 14]

図14

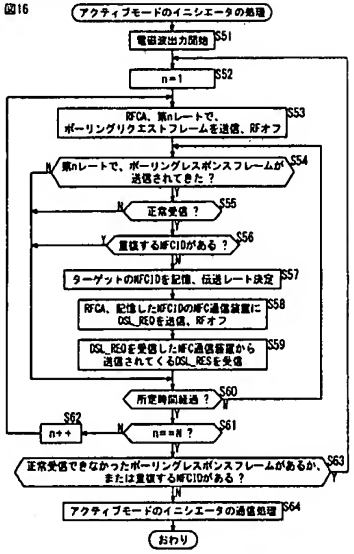



[Drawing 15]

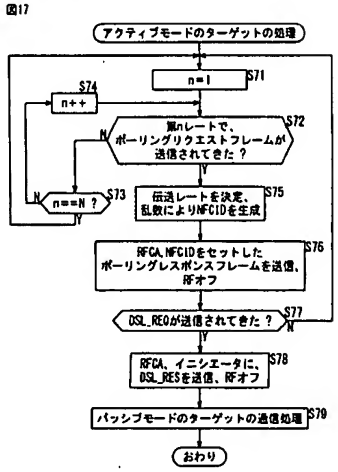
図15



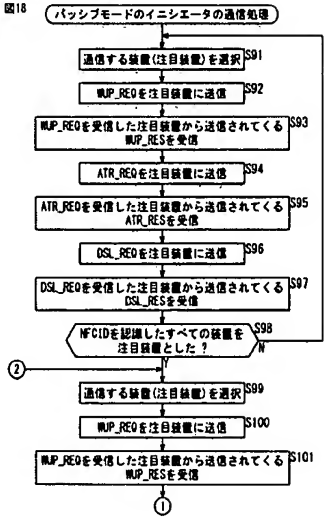
[Drawing 16]



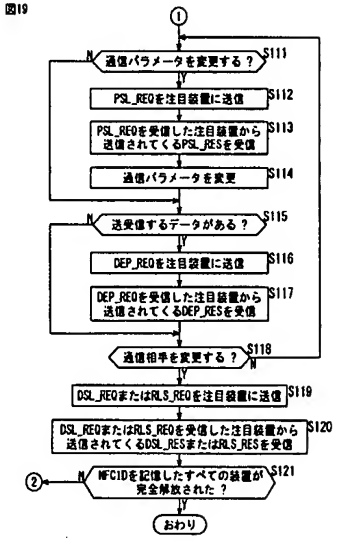

[Drawing 17]




[Drawing 18]

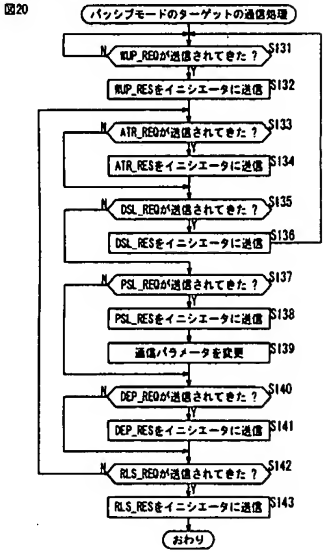



[Drawing 19]



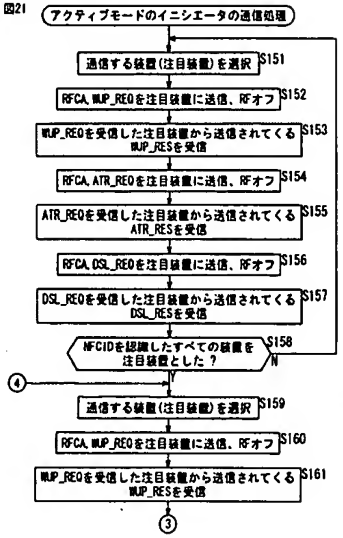
[Drawing 20]

図20



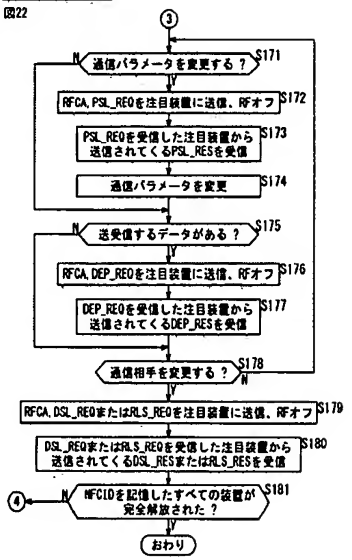

[Drawing 21]

図21



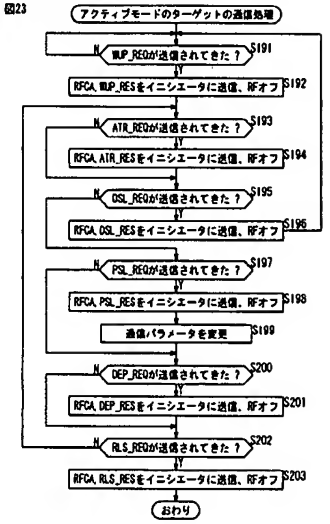

[Drawing 22]

図22




[Drawing 23]

図23



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CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law

[Section partition] The 3rd partition of the 7th section

[Publication date] September 2, Heisei 17 (2005. 9.2)

[Publication No.] JP,2004-200840,A (P2004-200840A)

[Date of Publication] July 15, Heisei 16 (2004. 7.15)

[Annual volume number] Public presentation / registration official report 2004-027

[Application number] Application for patent 2002-364746 (P2002-364746)

[The 7th edition of International Patent Classification]

H04B 5/02

G06K 17/00

// H04L 9/32

[FI]

H04B 5/02

G06K 17/00 F

H04L 9/00 673 B

[Procedure revision]

[Filing Date] March 2, Heisei 17 (2005. 3.2)

[Procedure amendment 1]

[Document to be Amended] Specification

[Item(s) to be Amended] 0002

[Method of Amendment] Modification

[The contents of amendment]

[0002]

[Description of the Prior Art]

As a system which performs a contiguity communication link, IC (Integrated Circuit) system is known widely, for example. In IC card system, when reader/writer generates an electromagnetic wave, the so-called RF (Radio Frequency) field (field) is formed. And by electromagnetic induction, if an IC card approaches reader/writer, an IC card will perform data transmission between reader/writers while receiving supply of a power source (for example, patent reference 1).

[Procedure amendment 2]

[Document to be Amended] Specification

[Item(s) to be Amended] 0006

[Method of Amendment] Modification

[The contents of amendment]

[0006]

Type C is adopted as a FeliCa method of Sony Corp. which is this applicant, and encoding of the data based on Manchester is carried out to the data transmission between reader/writer and an IC card. Moreover, by Type C, 212kbps is adopted as a transmission rate of data.

[Patent reference 1] JP,10-13312,A

[Procedure amendment 3]

[Document to be Amended] Specification

[Item(s) to be Amended] 0071

[Method of Amendment] Modification

[The contents of amendment]

[0071]

In the recovery section 13 constituted as mentioned above, the signal which a receive section 12 outputs is supplied to the adjustable rate recovery section 51 and the rate detecting element 52. The rate detecting element 52 is directed in the adjustable rate recovery section 51 so that the transmission rate of the signal supplied from a receive section 12 may detect any of the transmission rates as N of the 1st thru/or ** a Nth they are and may restore to the signal of the transmission rate. And the adjustable rate recovery section 51 restores to the signal supplied from a receive section 12 as a

signal of the transmission rate according to the directions from the rate detecting element 52, and supplies the recovery result to the decoding section 14.

[Procedure amendment 4]

[Document to be Amended] Specification

[Item(s) to be Amended] 0083

[Method of Amendment] Modification

[The contents of amendment]

[0083]

The NFC communication device which is going to output an electromagnetic wave in the active mode detects the electromagnetic wave by other equipments, and after only the output to the time amount TARFG passes [ the electromagnetic wave by other equipments ] by starting the output of an electromagnetic wave when only time amount TADT+nxTRFW is not detected continuously, it starts transmission (Send Response) of data.

[Procedure amendment 5]

[Document to be Amended] Specification

[Item(s) to be Amended] 0103

[Method of Amendment] Modification

[The contents of amendment]

[0103]

In addition, when an initiator transmits a polling request frame again, and when [ all target #1 thru/or #5 ] a polling response frame is returned, possibility that polling response frames will start collision is size again. Then, in a target, when a polling request frame is again received so much for time amount as a dish after receiving a polling request frame from an initiator, the polling request frame can be disregarded, for example. However, since an initiator cannot recognize that NFCID of target #1 and #3 about target #1 which has produced the collision of a polling response to the polling request frame transmitted first with the gestalt of operation of drawing 11 in this case, and #3, an exchange of the data between target #1 or #3 can be performed.

[Procedure amendment 6]

[Document to be Amended] Specification

[Item(s) to be Amended] 0117

[Method of Amendment] Modification

[The contents of amendment]

[0117]

Response ATR_RES is transmitted to an initiator as a response to the command ATR_REQ, when a target receives command ATR_REQ. An attribute, NFCID, etc. of a target are arranged at response ATR_RES.

[Procedure amendment 7]

[Document to be Amended] Specification

[Item(s) to be Amended] 0118

[Method of Amendment] Modification

[The contents of amendment]

[0118]

In addition, all the transmission rates of the data which can transmit and receive an initiator and a target can be included in the information on the transmission rate as an attribute arranged at command ATR_REQ or response ATR_RES. In this case, between an initiator and a target, only by the exchange of command ATR_REQ and response ATR_RES being performed once, the transmission rate which can transmit and receive a target can be recognized and, as for an initiator, a target can also recognize the transmission rate which can transmit and receive an initiator.

[Procedure amendment 8]

[Document to be Amended] Specification

[Item(s) to be Amended] 0154

[Method of Amendment] Modification

[The contents of amendment]

[0154]

While a NFC communication device transmits a polling request frame at the transmission rate as N in step S21 on the other hand when it judges that Variable n is equal to Maximum N namely, It judges whether there were some which overlap into NFCID of other equipments recognized whether it progressed to step S23, the NFC communication device originated in the polling response frame having been transmitted to coincidence from two or more equipments etc., and there was any polling response frame which was not able to carry out normal reception when the polling response frame which comes by each transmission rate on the contrary was received at step S16.

[Procedure amendment 9]

[Document to be Amended] Specification

[Item(s) to be Amended] 0167

[Method of Amendment] Modification

[The contents of amendment]

[0167]

When it is judged with command DSL_REQ having been transmitted from the initiator in the passive mode in step S37 on the other hand (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S38, and a NFC communication device transmits response DSL_RES to command DSL_REQ, will be in a DISEREKUTO condition, and will progress to step S39.

[Procedure amendment 10]

[Document to be Amended] Specification

[Item(s) to be Amended] 0182

[Method of Amendment] Modification

[The contents of amendment]

[0182]

Then, it progresses to step S58, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits command DSL_REQ to the target (target in the active mode) of NFCID memorized at step S57 at the n-th rate. Thereby, the target will be in the DISEREKUTO condition which does not answer the polling request frame transmitted henceforth. Then, a NFC communication device performs RF off processing, and progresses to S59 from step S58.

[Procedure amendment 11]

[Document to be Amended] Specification

[Item(s) to be Amended] 0188

[Method of Amendment] Modification

[The contents of amendment]

[0188]

While a NFC communication device transmits a polling request frame at the transmission rate as N in step S61 on the other hand when it judges that Variable n is equal to Maximum N namely, It judges whether there were some which overlap into NFCID of other equipments recognized whether it progressed to step S63, the NFC communication device originated in the polling response frame having been transmitted to coincidence from two or more equipments etc., and there was any polling response frame which was not able to carry out normal reception when the polling response frame which comes by each transmission rate on the contrary was received at step S56.

[Procedure amendment 12]

[Document to be Amended] Specification

[Item(s) to be Amended] 0199

[Method of Amendment] Modification

[The contents of amendment]

[0199]

When it is judged with command DSL_REQ having been transmitted from the initiator in the passive mode in step S77 on the other hand (i.e., when a NFC communication device receives command DSL_REQ), it progresses to step S78, and a NFC communication device starts the output of an electromagnetic wave by active RFCA processing, and transmits response DSL_RES to command DSL_REQ. Furthermore, at step S78, a NFC communication device performs RF OFF processing, will be in a DISEREKUTO condition, and will progress to step S79.

[Procedure amendment 13]

[Document to be Amended] Specification

[Item(s) to be Amended] 0202

[Method of Amendment] Modification

[The contents of amendment]

[0202]

In step S91, the NFC communication device which is the initiator in the passive mode chooses the equipment (suitably henceforth attention equipment) which communicates from the targets which memorized NFCID at step S17 of drawing 14, and progresses to step S92. At step S92, command WUP_REQ is transmitted to attention equipment and this cancels the DISEREKUTO condition of the attention equipment made into the DISEREKUTO condition by transmitting command DSL_REQ at step S19 of drawing 14 (it is suitably said for the Wake rise that it carries out hereafter).

[Procedure amendment 14]

[Document to be Amended] Specification

[Item(s) to be Amended] 0221

[Method of Amendment] Modification

[The contents of amendment]

[0221]

Here, as mentioned above, when a NFC communication device transmits command DSL_REQ or RLS_REQ to attention equipment, the target as the attention equipment is released from the object of the communication link with the NFC communication device as an initiator. However, although the target released by command DSL_REQ will be in an initiator and the condition which can be communicated again by command WUP_REQ, the target released by command RLS_REQ will not be in an initiator and

the condition which can be communicated, unless the exchange of the polling request frame mentioned above and a polling response frame is performed between initiators.
[Procedure amendment 15]
[Document to be Amended] Specification
[Item(s) to be Amended] 0223
[Method of Amendment] Modification
[The contents of amendment]
[0223]
Here, hereafter, suitably, between a target and an initiator, if the exchange of a polling request frame and a polling response frame is not performed, release of the target an initiator and whose communication link are not attained will be called full release. Moreover, release of the target an initiator and whose communication link are attained again is called release by transmitting command WUP_REQ from an initiator temporarily.
[Procedure amendment 16]
[Document to be Amended] Specification
[Item(s) to be Amended] 0224
[Method of Amendment] Modification
[The contents of amendment]
[0224]
After processing of step S120 progresses to step S121, and a NFC communication device judges whether full release of all the targets that memorized NFCID at step S17 of drawing 14 was carried out. In step S121, when judged with full release of all the targets that memorized NFCID not being carried out yet, to step S99 of drawing 18, return and a NFC communication device newly choose attention equipment, and repeat the same processing hereafter out of the target by which full release is not carried out, i.e., the target released temporarily.
[Procedure amendment 17]
[Document to be Amended] Specification
[Item(s) to be Amended] 0226
[Method of Amendment] Modification
[The contents of amendment]
[0226]
In addition, in steps S116 and S117 of drawing 19, although transmission and reception (data exchange) of data are performed between a target and an initiator by exchanging command DEP_REQ and response DEP_RES, the exchange of this command DEP_REQ and response DEP_RES is one transaction. Through steps S118, S111, S112, and S113, after processing of steps S116 and S117 can be returned to step S114, and can change a communications parameter. Therefore, communications parameters, such as a transmission rate about the communication link between a target and an initiator, can be changed for every transaction.
[Procedure amendment 18]
[Document to be Amended] Specification
[Item(s) to be Amended] 0231
[Method of Amendment] Modification
[The contents of amendment]
[0231]
Moreover, in step S131, when judged with command WUP_REQ having been transmitted from the initiator (i.e., when a NFC communication device receives command WUP_REQ), it progresses to step S132, and a NFC communication device transmits response WUP_RES to command WUP_REQ, carries out the Wake rise, and progresses to step S133.
[Procedure amendment 19]
[Document to be Amended] Specification
[Item(s) to be Amended] 0233
[Method of Amendment] Modification
[The contents of amendment]
[0233]
Moreover, in step S133, when judged with command ATR_REQ having been transmitted from an initiator (i.e., when a NFC communication device receives command ATR_REQ), it progresses to step S134, and a NFC communication device transmits response ATR_RES to command ATR_REQ, and progresses to step S135.
[Procedure amendment 20]
[Document to be Amended] Specification
[Item(s) to be Amended] 0245
[Method of Amendment] Modification
[The contents of amendment]
[0245]
As mentioned above, in an initiator, NFCID arranged at the polling response frame which the polling request frame which requires NFCID which identifies a target is transmitted, and a target transmits as a response to the polling request frame is acquired. And in an initiator, when NFCID of a target is not able to be acquired

normally, it retransmits a message to a polling request frame. On the other hand, if the polling request frame from an initiator is received, a target will generate own NFCID with a random number, will arrange it to a polling response frame, and will be transmitted to an initiator. Furthermore, when a polling request frame is re-received from an initiator, a target carries out regeneration of the own NFCID with a random number, arranges it to a polling response frame, and is broadcast again to an initiator.

[Procedure amendment 21]

[Document to be Amended] DRAWINGS

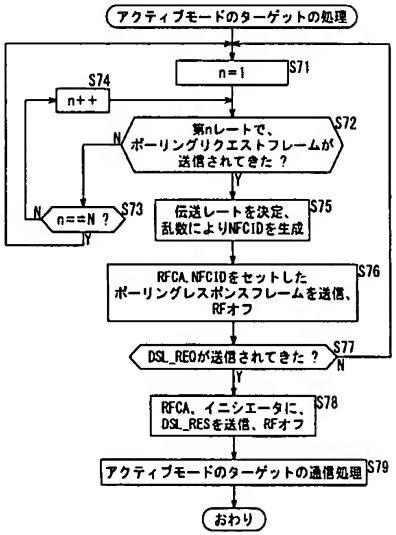
[Item(s) to be Amended] drawing 17

[Method of Amendment] Modification

[The contents of amendment]

[Drawing 17]

図17

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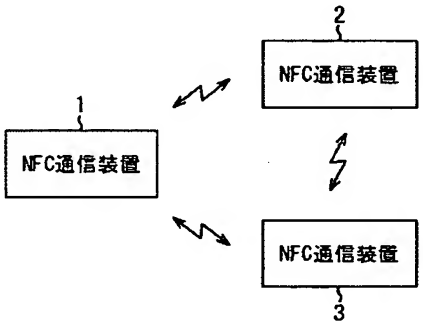
最終頁に続く

(54)【発明の名称】通信装置および通信方法

(57)【要約】
【課題】２以上の通信相手から同時に応答が返ってくることを防止する。
【解決手段】NFC通信装置１は、IDを要求するデータを送信し、その要求に応じてNFC通信装置２と３が送信してくるIDを取得する。そして、NFC通信装置１は、NFC通信装置２と３のIDの取得後は、NFC通信装置２と３に対するデータとして、それぞれのIDを含むデータを送信する。一方、NFC通信装置１は、NFC通信装置２と３のIDを正常に取得することができなかった場合、IDを要求するデータを再送信する。NFC通信装置２と３は、IDの要求を受信した場合、自身のIDを乱数により生成して送信する。また、NFC通信装置２と３は、IDの要求を再受信した場合、自身のIDを乱数により再生成して再送信する。本発明は、例えばICカードシステムに適用できる。
【選択図】　図１

図1




通信システム

【特許請求の範囲】
【請求項１】
電磁波によりデータを送受信する通信装置において、
電磁波を発生することにより、RF(Radio Frequency)フィールドを形成する電磁波発生手段と、
電磁波を変調することにより、複数の伝送レートのうちのいずれかの伝送レートでデータを送信する変調手段と、
電磁波を復調することにより、複数の伝送レートのうちのいずれかの伝送レートで、他の装置から送信されてくるデータを取得する復調手段と
を備え、
前記他の装置を識別するID(Identification)を要求するデータを送信し、
前記IDの要求に応じて前記他の装置が送信してくる前記IDを取得し、
前記他の装置のIDの取得後は、前記他の装置に対するデータとして、前記他の装置のIDを含むデータを送信し、
前記他の装置のIDを正常に取得することができなかった場合、前記IDを要求するデータを再送信する
ことを特徴とする通信装置。
【請求項２】
複数の前記他の装置から、前記IDが同時に送信されてきた場合、または複数の前記他の装置から送信されてきたIDが重複する場合、前記IDを要求するデータを再送信する
ことを特徴とする請求項１に記載の通信装置。
【請求項３】
電磁波によりデータを送受信する通信方法において、
電磁波を発生することにより、RF(Radio Frequency)フィールドを形成する電磁波発生ステップと、
電磁波を変調することにより、複数の伝送レートのうちのいずれかの伝送レートでデータを送信する変調ステップと、
電磁波を復調することにより、複数の伝送レートのうちのいずれかの伝送レートで、他の装置から送信されてくるデータを取得する復調ステップと
を備え、
前記他の装置を識別するID(Identification)を要求するデータを送信し、
前記IDの要求に応じて前記他の装置が送信してくる前記IDを取得し、
前記他の装置のIDの取得後は、前記他の装置に対するデータとして、前記他の装置のIDを含むデータを送信し、
前記他の装置のIDを正常に取得することができなかった場合、前記IDを要求するデータを再送信する
ことを特徴とする通信方法。
【請求項４】
電磁波によりデータを送受信する通信装置において、
電磁波を変調することにより、複数の伝送レートのうちのいずれかの伝送レートでデータを送信する変調手段と、
電磁波を復調することにより、複数の伝送レートのうちのいずれかの伝送レートで、他の装置から送信されてくるデータを取得する復調手段と
を備え、
前記他の装置から、自身を識別するID(Identification)を要求するデータを受信した場合に、自身のIDを乱数により生成して送信し、
前記他の装置から、IDを要求するデータを再受信した場合に、自身のIDを乱数により再生成して再送信し、
前記他の装置から送信されてくるデータのうちの前記自身のIDを含むデータを、自身に対するデータとして受信する

ことを特徴とする通信装置。
【請求項５】
電磁波を発生することにより、RF(Radio Frequency)フィールドを形成する電磁波発生手段をさらに備え、
前記変調手段は、前記電磁波発生手段が出力する電磁波を変調することにより、データを送信する
ことを特徴とする請求項４に記載の通信装置。
【請求項６】
前記変調手段は、前記他の装置が発生する電磁波を負荷変調することにより、データを送信する
ことを特徴とする請求項４に記載の通信装置。
【請求項７】
電磁波によりデータを送受信する通信方法において、
電磁波を変調することにより、複数の伝送レートのうちのいずれかの伝送レートでデータを送信する変調ステップと、
電磁波を復調することにより、複数の伝送レートのうちのいずれかの伝送レートで、他の装置から送信されてくるデータを取得する復調ステップと
を備え、
前記他の装置から、自身を識別するID(Identification)を要求するデータを受信した場合に、自身のIDを乱数により生成して送信し、
前記他の装置から、IDを要求するデータを再受信した場合に、自身のIDを乱数により再生成して再送信し、
前記他の装置から送信されてくるデータのうちの前記自身のIDを含むデータを、自身に対するデータとして受信する
ことを特徴とする通信方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】
本発明は、通信装置および通信方法に関し、例えば、近接通信等において、複数の通信相手それぞれを確実に識別して、２以上の通信相手から同時に応答が返ってくることを防止することができるようにする通信装置および通信方法に関する。
【０００２】
【従来の技術】
近接通信を行うシステムとしては、例えば、IC(Integrated Curcuit)システムが広く知られている。ICカードシステムにおいては、リーダ／ライタが電磁波を発生することにより、いわゆるRF(Radio Frequency)フィールド（磁界）を形成する。そして、リーダ／ライタに、ICカードが近づくと、ICカードは、電磁誘導によって、電源の供給を受けるとともに、リーダ／ライタとの間でデータ伝送を行う（例えば、特許文献１）。
【０００３】
現在実施されているICカードシステムの仕様としては、例えば、タイプＡ、タイプＢ、タイプＣと呼ばれているものがある。
【０００４】
タイプＡは、フィリップス社のMIFARE方式として採用されているもので、リーダ／ライタからICカードへのデータ伝送には、Millerによるデータのエンコードが行われ、ICカードからリーダ／ライタへのデータ伝送には、Manchesterによるデータのエンコードが行われる。また、タイプＡでは、データの伝送レートとして、106kbps(kilo bit per second)が採用されている。
【０００５】
タイプＢでは、リーダ／ライタからICカードへのデータ伝送には、NRZによるデータのエンコードが行われ、ICカードからリーダ／ライタへのデータ伝送には、NRZ-Lよるデータ

のエンコードが行われる。また、タイプＢでは、データの伝送レートとして、106kbpsが採用されている。

【０００６】

タイプＣは、本件出願人であるソニー株式会社のFeliCa方式として採用されているもので、リーダ／ライタとICカードとの間のデータ伝送には、Manchesterによるデータのエンコードが行われる。また、タイプＣでは、データの伝送レートとして、212kbpsが採用されている。

【０００７】

【発明が解決しようとする課題】

ところで、ICカードシステムにおいて、１つのリーダ／ライタに対して、複数のICカードが接近してきた場合には、リーダ／ライタが、その複数のICカードそれぞれを識別し、通信相手を特定して、通信を行う必要がある。

【０００８】

複数のICカードを識別する方法としては、ICカードにユニークな識別番号としてのIDを割り当て、そのIDを、ICカードからリーダ／ライタに報告させる方法がある。

【０００９】

このように、ICカードにユニークなIDを割り当てる場合には、ICカードどうして、IDが重複することはない。しかしながら、この場合、そのユニークなIDを常時記憶しておくためのEEPROM(Electrically Erasable Programmable Read Only Memory)などのメモリが必要となる。従って、ICカードに、EEPROMが必要でない場合でも、IDを記憶させておくのに、EEPROMを設ける必要があり、ICカードの製造コストがコスト高になる。

【００１０】

そこで、ICカードにおいて、乱数を発生し、その乱数を、自身のIDとして、一時的に使用する方法がある。この方法によれば、IDを常時記憶しておく必要はないので、IDを記憶させるためのEEPROMを設ける必要はない。

【００１１】

しかしながら、乱数をIDとして用いる場合には、複数のICカードにおいて、同一の乱数が、IDとして用いられることが生じうる。この場合、リーダ／ライタが、そのID宛にデータを送信すると、複数のICカードが同時に応答することによって混信（コリジョン）が生じ、リーダ／ライタが、ICカードからの応答を正常に取得することができないことになる。

【００１２】

本発明は、このような状況に鑑みてなされたものであり、複数の通信相手それぞれを確実に識別して、２以上の通信相手から同時に応答が返ってくることを防止することができるようにするものである。

【００１３】

【課題を解決するための手段】

本発明の第１の通信装置は、他の装置を識別するID(Identification)を要求するデータを送信し、IDの要求に応じて他の装置が送信してくるIDを取得し、他の装置のIDの取得後は、他の装置に対するデータとして、他の装置のIDを含むデータを送信し、他の装置のIDを正常に取得することができなかった場合、IDを要求するデータを再送信することを特徴とする。

【００１４】

本発明の第１の通信方法は、他の装置を識別するID(Identification)を要求するデータを送信し、IDの要求に応じて他の装置が送信してくるIDを取得し、他の装置のIDの取得後は、他の装置に対するデータとして、他の装置のIDを含むデータを送信し、他の装置のIDを正常に取得することができなかった場合、IDを要求するデータを再送信することを特徴とする。

【００１５】

本発明の第２の通信装置は、他の装置から、自身を識別するID(Identification)を要求するデータを受信した場合に、自身のIDを乱数により生成して送信し、他の装置から、IDを

要求するデータを再受信した場合に、自身のIDを乱数により再生成して再送信し、他の装置から送信されてくるデータのうちの自身のIDを含むデータを、自身に対するデータとして受信することを特徴とする。

【００１６】

本発明の第２の通信方法は、他の装置から、自身を識別するID(Identification)を要求するデータを受信した場合に、自身のIDを乱数により生成して送信し、他の装置から、IDを要求するデータを再受信した場合に、自身のIDを乱数により再生成して再送信し、他の装置から送信されてくるデータのうちの自身のIDを含むデータを、自身に対するデータとして受信することを特徴とする。

【００１７】

本発明の第１の通信装置および通信方法においては、他の装置を識別するID(Identification)を要求するデータが送信され、IDの要求に応じて他の装置が送信してくるIDが取得される。そして、他の装置のIDの取得後は、他の装置に対するデータとして、他の装置のIDを含むデータが送信される。一方、他の装置のIDを正常に取得することができなかった場合、IDを要求するデータが再送信される。

【００１８】

本発明の第２の通信装置および通信方法においては、他の装置から、自身を識別するID(Identification)を要求するデータを受信した場合に、自身のIDが乱数により生成されて送信される。また、他の装置から、IDを要求するデータを再受信した場合に、自身のIDが乱数により再生成されて再送信される。そして、他の装置から送信されてくるデータのうちの自身のIDを含むデータが、自身に対するデータとして受信される。

【００１９】

【発明の実施の形態】

図１は、本発明を適用した通信システム（システムとは、複数の装置が論理的に結合したもの物をいい、各構成の装置が同一筐体中にあるか否かは問わない）の一実施の形態の構成例を示している。

【００２０】

図１においては、通信システムは、３つのNFC通信装置１，２，３から構成されている。NFC通信装置１乃至３それぞれは、他のNFC通信装置との間で、単一の周波数の搬送波を使用した、電磁誘導による近接通信（NFC(Near Field Communication)）を行うことができるようになっている。

【００２１】

ここで、NFC通信装置１乃至３が使用する搬送波の周波数としては、例えば、ISM(Industrial Scientific Medical)バンドの13.56MHzなどを採用することができる。

【００２２】

また、近接通信とは、通信する装置どうしの距離が、数10cm以内となって可能となる通信を意味し、通信する装置どうし（の筐体）が接触して行う通信も含まれる。

【００２３】

なお、図１の通信システムは、NFC通信装置１乃至３のうちの１以上をリーダ／ライタとするとともに、他の１以上をICカードとするICカードシステムとして採用することができることは勿論、NFC通信装置１乃至３それぞれを、PDA(Personal Digital Assistant)、PC（Personal Computer）、携帯電話、腕時計、ペン等の通信システムとして採用することも可能である。即ち、NFC通信装置１乃至３は、近接通信を行う装置であり、ICカードシステムのICカードやリーダ／ライタなどに限定されるものではない。

【００２４】

NFC通信装置１乃至３は、第１に、２つの通信モードによる通信が可能であることと、第２に、複数の伝送レートによるデータ伝送が可能であることとの２つの特徴を有している。

【００２５】

２つの通信モードとしては、パッシブモードとアクティブモードとがある。いま、NFC通

信装置１乃至３のうちの、例えば、NFC通信装置１と２の間の通信に注目すると、パッシブモードでは、上述した従来のICカードシステムと同様に、NFC通信装置１と２のうちの一方のNFC通信装置である、例えば、NFC通信装置１は、自身が発生する電磁波（に対応する搬送波）を変調することにより、他方のNFC通信装置であるNFC通信装置２にデータを送信し、NFC通信装置２は、NFC通信装置１が発生する電磁波（に対応する搬送波）を負荷変調することにより、NFC通信装置１にデータを送信する。

【００２６】

一方、アクティブモードでは、NFC通信装置１と２のいずれも、自身が発生する電磁波（に対応する搬送波）を変調することにより、データを送信する。

【００２７】

ここで、電磁誘導による近接通信を行う場合、最初に電磁波を出力して通信を開始し、いわば通信の主導権を握る装置を、イニシエータと呼ぶ。イニシエータは、通信相手にコマンドを送信し、その通信相手は、そのコマンドに対するレスポンスを返す形で、近接通信が行われるが、イニシエータからのコマンドに対するレスポンスを返す通信相手を、ターゲットと呼ぶ。

【００２８】

例えば、いま、NFC通信装置１が電磁波の出力を開始して、NFC通信装置２との通信を開始したとすると、図２および図３に示すように、NFC通信装置１がイニシエータとなり、NFC通信装置２がターゲットとなる。

【００２９】

そして、パッシブモードでは、図２に示すように、イニシエータであるNFC通信装置１が電磁波を出力し続け、NFC通信装置１は、自身が出力している電磁波を変調することにより、ターゲットであるNFC通信装置２に、データを送信するとともに、NFC通信装置２は、イニシエータであるNFC通信装置１が出力している電磁波を負荷変調することにより、NFC通信装置１に、データを送信する。

【００３０】

一方、アクティブモードでは、図３に示すように、イニシエータであるNFC通信装置１は、自身がデータを送信する場合に、自身で電磁波の出力を開始し、その電磁波を変調することにより、ターゲットであるNFC通信装置２に、データを送信する。そして、NFC通信装置１は、データの送信終了後は、電磁波の出力を停止する。ターゲットであるNFC通信装置２も、自身がデータを送信する場合に、自身で電磁波の出力を開始し、その電磁波を変調することにより、イニシエータであるNFC通信装置１に、データを送信する。そして、NFC通信装置２は、データの送信終了後は、電磁波の出力を停止する。

【００３１】

なお、NFC通信装置１乃至３が、複数の伝送レートによるデータ伝送が可能であるという第２の特徴点については、後述する。

【００３２】

また、図１では、３つのNFC通信装置１乃至３によって、通信システムが構成されているが、通信システムを構成するNFC通信装置は、３つに限定されるものではなく、２または４以上であっても良い。さらに、通信システムは、NFC通信装置の他、例えば、従来のICカードシステムを構成するICカードやリーダ／ライタなどを含めて構成することも可能である。

【００３３】

次に、図４は、図１のNFC通信装置１の構成例を示している。なお、図１の他のNFC通信装置２および３も、図４のNFC通信装置１と同様に構成されるため、その説明は、省略する。

【００３４】

アンテナ１１は、閉ループのコイルを構成しており、このコイルに流れる電流が変化することで、電磁波を出力する。また、アンテナ１１としてのコイルを通る磁束が変化することで、アンテナ１１に電流が流れる。

【００３５】
受信部１２は、アンテナ１１に流れる電流を受信し、同調と検波を行い、復調部１３に出力する。復調部１３は、受信部１２から供給される信号を復調し、デコード部１４に供給する。デコード部１４は、復調部１３から供給される信号としての、例えばマンチェスタ符号などをデコードし、そのデコードの結果得られるデータを、データ処理部１５に供給する。
【００３６】
データ処理部１５は、デコード部１４から供給されるデータに基づき、例えば、トランスポート層などのプロトコルで行うべき処理、その他の所定の処理を行う。また、データ処理部１５は、他の装置に送信すべきデータを、エンコード部１６に供給する。さらに、データ処理部１５は、乱数発生部２４から供給される乱数を受信し、その乱数から、NFC通信装置自身を特定する情報としてのNFCID(NFC Identification)を生成する。データ処理部１５は、他の装置から、後述するポーリングリクエストフレームによってNFCIDを要求された場合、乱数発生部２４から供給される乱数から生成したNFCIDを、自身を特定するNFCIDとして、後述するポーリングレスポンスフレームに配置し、エンコード部１６に供給する。
【００３７】
エンコード部１６は、データ処理部１５から供給されるデータを、例えば、マンチェスタ符号などにエンコードし、選択部１７に供給する。選択部１７は、変調部１９または負荷変調部２０のうちのいずれか一方を選択し、その選択した方に、エンコード部１６から供給される信号を出力する。
【００３８】
ここで、選択部１７は、制御部２１の制御にしたがって、変調部１９または負荷変調部２０を選択する。制御部２１は、通信モードがパッシブモードであり、NFC通信装置１がターゲットとなっている場合は、選択部１７に負荷変調部２０を選択させる。また、制御部２１は、通信モードがアクティブモードである場合、または通信モードがパッシブモードであり、かつ、NFC通信装置１がイニシエータとなっている場合は、選択部１７に変調部１９を選択させる。従って、エンコード部１６が出力する信号は、通信モードがパッシブモードであり、NFC通信装置１がターゲットとなっているケースでは、選択部１７を介して、負荷変調部２０に供給されるが、他のケースでは、選択部１７を介して、変調部１９に供給される。
【００３９】
電磁波出力部１８は、アンテナ１１から、所定の単一の周波数の搬送波（の電磁波）を放射させるための電流を、アンテナ１１に流す。変調部１９は、電磁波出力部１８がアンテナ１１に流す電流としての搬送波を、選択部１７から供給される信号にしたがって変調する。これにより、アンテナ１１からは、データ処理部１５がエンコード部１６に出力したデータにしたがって搬送波を変調した電磁波が放射される。
【００４０】
負荷変調部２０は、外部からアンテナ１１としてのコイルを見たときのインピーダンスを、選択部１７から供給される信号にしたがって変化させ、これにより、負荷変調を行う。他の装置が搬送波としての電磁波を出力することにより、アンテナ１１の周囲にRFフィールド（磁界）が形成されている場合、アンテナ１１としてのコイルを見たときのインピーダンスが変化することにより、アンテナ１１の周囲のRFフィールドも変化する。これにより、他の装置が出力している電磁波としての搬送波が、選択部１７から供給される信号にしたがって変調され、データ処理部１５がエンコード部１６に出力したデータが、電磁波を出力している他の装置に送信される。
【００４１】
ここで、変調部１９および負荷変調部２０における変調方式としては、例えば、振幅変調(ASK(Amplitude Shift Keying))を採用することができる。但し、変調部１９および負荷変調部２０における変調方式は、ASKに限定されるものではなく、PSK(Phase Shift Keyin

g)やQAM(Quadrature Amplitude Modulation)その他を採用することが可能である。また、振幅の変調度についても8%から30%、50%、100%等数値に限定されることはなく、好適なものを選択すれば良い。

【００４２】

制御部２１は、NFC通信装置１を構成する各ブロックを制御する。電源部２２は、NFC通信装置１を構成する各ブロックに、必要な電源を供給する。なお、図４では、制御部２１がNFC通信装置１を構成する各ブロックを制御することを表す線の図示と、電源部２２がNFC通信装置１を構成する各ブロックに電源を供給することを表す線の図示は、図が煩雑になるため、省略してある。

【００４３】

検出部２３は、受信部１２と同様に、アンテナ１１に流れる電流を受信し、その電流に基づいて、所定のレベル（磁束密度）以上の電磁波がアンテナ１１で受信されているかどうかを検出する。

【００４４】

乱数発生部２４は、乱数を発生し、データ処理部１５に供給する。

【００４５】

ここで、上述の場合には、デコード部１４およびエンコード部１６において、前述のタイプＣで採用されているマンチェスタ符号を処理するようにしたが、デコード部１４およびエンコード部１６では、マンチェスタ符号だけでなく、タイプＡで採用されているモディファイドミラーや、タイプＣで採用されているNRZなどの複数種類の符号の中から１つを選択して処理するようにすることが可能である。

【００４６】

次に、図５は、図４の復調部１３の構成例を示している。

【００４７】

図５では、復調部１３は、選択部３１、２以上であるＮ個の復調部$32_1$乃至$32_N$、および選択部３３から構成されている。

【００４８】

選択部３１は、制御部２１（図４）の制御にしたがい、Ｎ個の復調部$32_1$乃至$32_N$の中から、１つの復調部$32_n$（ｎ＝１，２，・・・，Ｎ）を選択し、その選択した復調部$32_n$に、受信部１２が出力する信号を供給する。

【００４９】

復調部$32_n$は、第ｎの伝送レートで送信されてきた信号を復調し、選択部３３に供給する。ここで、復調部$32_n$と復調部$32_{n'}$（$n \neq n'$）は、異なる伝送レートで送信されてきた信号を復調する。従って、図５の復調部１３は、第１乃至第ＮのＮ通りの伝送レートで送信されてくる信号を復調することができるようになっている。なお、Ｎ通りの伝送レートとしては、例えば、前述した106kbps，212kbps、さらには、より高速の424kbps，848kbpsなどを採用することができる。即ち、Ｎ通りの伝送レートには、例えば、既存のICカードシステムなどの近接通信において既に採用されている伝送レートと、それ以外の伝送レートとを含めることができる。

【００５０】

選択部３３は、制御部２１の制御にしたがい、Ｎ個の復調部$32_1$乃至$32_N$の中から、１つの復調部$32_n$を選択し、その復調部$32_n$で得られた復調出力を、デコード部１４に供給する。

【００５１】

以上のように構成される復調部１３では、制御部２１（図４）は、例えば、選択部３１に、Ｎ個の復調部$32_1$乃至$32_N$を順次選択させ、これにより、復調部$32_1$乃至$32_N$それぞれに、受信部１２から選択部３１を介して供給される信号を復調させる。そして、制御部２１は、例えば、受信部１２から選択部３１を介して供給される信号を正常に復調することができた復調部$32_n$を認識し、その復調部$32_n$の出力を選択するように、選択部３３を制御する。選択部３３は、制御部２１の制御にしたがい、復調部$32_n$を選択し、こ

れにより、復調部３２$_n$で得られた正常な復調出力が、デコード部１４に供給される。

【００５２】

従って、復調部１３では、Ｎ通りの伝送レートのうちの任意の伝送レートで伝送されてくる信号を復調することができる。

【００５３】

なお、復調部３２$_1$乃至３２$_N$は、正常に復調を行うことができた場合のみ、復調出力を出力し、正常に復調を行うことができなかった場合には、何も出力しない（例えば、ハイインピーダンスとなる）ようにすることができる。この場合、選択部３３は、復調部３２$_1$乃至３２$_N$の出力すべての論理和をとって、デコード部１４に出力すれば良い。

【００５４】

次に、図６は、図４の変調部１９の構成例を示している。

【００５５】

図６では、変調部１９は、選択部４１、２以上であるＮ個の変調部４２$_1$乃至４２$_N$、および選択部４３から構成されている。

【００５６】

選択部４１は、制御部２１（図４）の制御にしたがい、Ｎ個の変調部４２$_1$乃至４２$_N$の中から、１つの変調部４２$_n$（ｎ＝１，２，・・・，Ｎ）を選択し、その選択した変調部４２$_n$に、選択部１７（図４）が出力する信号を供給する。

【００５７】

変調部４２$_n$は、第ｎの伝送レートでデータの送信が行われるように、選択部４３を介して、アンテナ１１に流れる電流としての搬送波を、選択部４１から供給される信号にしたがって変調する。ここで、変調部４２$_n$と変調部４２$_{n'}$（ｎ≠ｎ’）は、搬送波を、異なる伝送レートで変調する。従って、図６の変調部１９は、第１乃至第ＮのＮ通りの伝送レートでデータを送信することができるようになっている。なお、Ｎ通りの伝送レートとしては、例えば、図５の復調部１３が復調することができるのと同一の伝送レートを採用することができる。

【００５８】

選択部４３は、制御部２１の制御にしたがい、Ｎ個の変調部４２$_1$乃至４２$_N$の中から、選択部４１が選択するのと同一の変調部４２$_n$を選択し、その変調部４２$_n$と、アンテナ１１とを電気的に接続する。

【００５９】

以上のように構成される変調部１９では、制御部２１（図４）は、例えば、選択部４１に、Ｎ個の変調部４２$_1$乃至４２$_N$を順次選択させ、これにより、変調部４２$_1$乃至４２$_N$それぞれに、選択部４１から供給される信号にしたがい、選択部４３を介して、アンテナ１１に流れる電流としての搬送波を変調させる。

【００６０】

従って、変調部１９では、Ｎ通りの伝送レートのうちの任意の伝送レートでデータが送信されるように、搬送波を変調してデータを送信することができる。

【００６１】

なお、図４の負荷変調部２０は、例えば、図６の変調部１９と同様に構成されるため、その説明は、省略する。

【００６２】

以上から、NFC通信装置１乃至３では、搬送波を、Ｎ通りの伝送レートのうちのいずれかの伝送レートで送信されるデータの信号に変調するとともに、Ｎ通りの伝送レートのうちのいずれかの伝送レートで送信されてくるデータの信号を復調することができる。そして、Ｎ通りの伝送レートには、例えば、上述したように、既存のICカードシステム（FeliCa方式など）などの近接通信において既に採用されている伝送レートと、それ以外の伝送レートとを含めることができる。従って、NFC通信装置１乃至３によれば、それぞれの間では、そのＮ通りの伝送レートのいずれの伝送レートでも、データのやりとりを行うことができる。さらに、NFC通信装置１乃至３によれば、既存のICカードシステムを構成するIC

カードやリーダ／ライタとの間でも、そのICカードやリーダ／ライタが採用している伝送レートで、データのやりとりを行うことができる。

【００６３】

そして、その結果、NFC通信装置１乃至３を、既存の近接通信が採用されているサービスに導入しても、ユーザが混乱等することはなく、従って、その導入を容易に行うことができる。さらに、将来登場することが予想される高速なデータレートによる近接通信が採用されるサービスにも、既存の近接通信との共存を図りながら、NFC通信装置１乃至３を、容易に導入することができる。

【００６４】

また、NFC通信装置１乃至３では、従来の近接通信で採用されていたパッシブモードの他、自身が電磁波を出力することによってデータを送信するアクティブモードでのデータ伝送が可能であるため、リーダ／ライタ等の他の装置を介さなくても、データのやりとりを直接行うことができる。

【００６５】

次に、図７は、図４の復調部１３の他の構成例を示している。なお、図中、図５における場合と対応する部分については、同一の符号を付してあり、以下では、その説明は、適宜省略する。即ち、図７の復調部１３は、選択部３１が設けられていない他は、図５における場合と基本的に同様に構成されている。

【００６６】

即ち、図７の実施の形態では、受信部１２が出力する信号は、復調部$32_1$乃至$32_N$に、同時に供給され、復調部$32_1$乃至$32_N$では、受信部１２からの信号が同時に復調される。そして、制御部２１は、例えば、受信部１２からの信号を正常に復調することができた復調部$32_n$を認識し、その復調部$32_n$を出力するように、選択部３３を制御する。選択部３３は、制御部２１の制御にしたがい、復調部$32_n$を選択し、これにより、復調部$32_n$で得られた正常な復調出力が、デコード部１４に供給される。

【００６７】

なお、図７の実施の形態では、復調部$32_1$乃至$32_N$に、常に、復調動作を行わせる必要がある。これに対して、図５の実施の形態では、復調部$32_1$乃至$32_N$のうちの、選択部３１に選択されているものだけに復調動作を行わせ、他のものは動作を停止させておくことができる。従って、装置の消費電力を節約する観点からは、図７よりも、図５の構成の方が有利である。一方、正常な復調出力を早期に得る観点からは、図５よりも、図７の構成の方が有利である。

【００６８】

次に、図８は、図４の復調部１３のさらに他の構成例を示している。

【００６９】

図８では、復調部１３は、可変レート復調部５１とレート検出部５２から構成されている。

【００７０】

可変レート復調部５１は、受信部１２から供給される信号を、レート検出部５２からの指示に応じた伝送レートの信号として復調し、その復調結果を、デコード部１４に供給する。レート検出部５２は、受信部１２から供給される信号の伝送レートを検出し、その伝送レートの信号を復調するように、可変レート復調部５１に指示する。

【００７１】

以上のように構成される復調部５１では、受信部１２が出力する信号が、可変レート復調部５１とレート検出部５２に供給される。レート検出部５２は、受信部１２から供給される信号の伝送レートが、例えば、第１乃至第ＮのＮ通りの伝送レートのうちのいずれであるかを検出し、その伝送レートの信号を復調するように、可変レート復調部５１に指示する。そして、可変レート復調部５１は、受信部１２から供給される信号を、レート検出部５２からの指示に応じた伝送レートの信号として復調し、その復調結果を、デコード部１４に供給する。

【００７２】
次に、NFC通信装置１乃至３は、いずれも、最初に電磁波を出力して通信を開始するイニシエータになり得る。さらに、アクティブモードでは、NFC通信装置１乃至３は、イニシエータとなる場合でも、ターゲットとなる場合でも、自身で電磁波を出力する。
【００７３】
従って、NFC通信装置１乃至３が近接している状態で、そのうちの２以上が同時に電磁波を出力した場合には、コリジョン(collision)が生じ、通信を行うことができなくなる。
【００７４】
そこで、NFC通信装置１乃至３それぞれは、他の装置からの電磁波（によるRFフィールド）が存在するかどうかを検出し、存在しない場合にのみ、電磁波の出力を開始し、これにより、コリジョンを防止するようになっている。ここで、このように、他の装置からの電磁波が存在するかどうかを検出し、存在しない場合にのみ、電磁波の出力を開始する処理を、コリジョンを防止するという目的から、RFCA(RF Collision Avoidance)処理という。
【００７５】
RFCA処理には、イニシエータとなろうとするNFC通信装置（図１では、NFC通信装置１乃至３のうちの１以上）が最初に行う初期RFCA処理と、アクティブモードでの通信中において、電磁波の出力を開始するNFC通信装置が、その開始をしようとするごとに行うレスポンスRFCA処理との２つがある。初期RFCA処理であっても、レスポンスRFCA処理であっても、電磁波の出力を開始する前に、他の装置による電磁波が存在するかどうかを検出し、存在しない場合にのみ、電磁波の出力を開始するという点は同一である。但し、初期RFCA処理とレスポンスRFCA処理とでは、他の装置による電磁波の存在が検出されなくなってから、電磁波の出力を開始しなければならないタイミングまでの時間等が異なる。
【００７６】
そこで、まず図９を参照して、初期RFCA処理について説明する。
【００７７】
図９は、初期RFCA処理によって出力が開始される電磁波を示している。なお、図９において（後述する図１０も同様）、横軸は時間を表し、縦軸は、NFC通信装置が出力する電磁波のレベルを表す。
【００７８】
イニシエータとなろうとするNFC通信装置は、常時、他の装置による電磁波の検出を行っており、他の装置による電磁波が、時間$T_{IDT}+n\times T_{RFW}$だけ連続して検出されなかった場合、電磁波の出力を開始し、その出力から時間$T_{IRFG}$だけ経過した後に、データ（コマンドを含む）の送信(Send Request)を開始する。
【００７９】
ここで、時間$T_{IDT}+n\times T_{RFW}$における$T_{IDT}$は、初期遅延時間と呼ばれ、搬送波の周波数を$f_c$で表すこととすると、例えば、４０９６／$f_c$より大の値が採用される。ｎは、例えば、０以上３以下の整数で、乱数を用いて生成される。$T_{RFW}$は、RF待ち時間と呼ばれ、例えば、５１２／$f_c$が採用される。時間$T_{IRFG}$は、初期ガードタイムと呼ばれ、例えば、５msより大の値が採用される。
【００８０】
なお、電磁波が検出されてはならない時間$T_{IDT}+n\times T_{RFW}$に、乱数であるｎを採用することにより、複数のNFC通信装置が同一のタイミングで、電磁波の出力を開始してしまう可能性の低減が図られている。
【００８１】
NFC通信装置が、初期RFCA処理によって、電磁波の出力を開始した場合、そのNFC通信装置は、イニシエータとなるが、その際、通信モードとして、アクティブモードが設定されたときには、イニシエータとなったNFC通信装置は、自身のデータの送信を終了した後、電磁波の出力を停止する。一方、通信モードとして、パッシブモードが設定されたときには、イニシエータとなったNFC通信装置は、ターゲットとの通信が完全に完了するまで、初期RFCA処理によって開始した電磁波の出力を、そのまま続行する。

【００８２】
次に、図１０は、レスポンスRFCA処理によって出力が開始される電磁波を示している。
【００８３】
アクティブモードにおいて電磁波を出力しようとするNFC通信装置は、他の装置による電磁波の検出を行い、他の装置による電磁波が、時間$T_{ADT}$ ＋ｎ×$T_{RFW}$ だけ連続して検出されなかった場合、電磁波の出力を開始し、その出力から時間$T_{ARFG}$ だけ経過した後に、データの送信(Send Responsese)を開始する。
【００８４】
ここで、時間$T_{ADT}$ ＋ｎ×$T_{RFW}$ におけるｎと$T_{RFW}$ は、図９の初期RFCA処理における場合と同一のものである。また、時間$T_{ADT}$ ＋ｎ×$T_{RFW}$ における$T_{ADT}$ は、アクティブディレイタイムと呼ばれ、例えば、７６８／$f_c$以上２５５９／$f_c$以下の値が採用される。時間$T_{ARFG}$ は、アクティブガードタイムと呼ばれ、例えば、１０２４／$f_c$より大の値が採用される。
【００８５】
図９と図１０から明らかなように、初期RFCA処理によって電磁波の出力を開始するには、少なくとも初期遅延時間$T_{IDT}$ の間、電磁波が存在してはならず、レスポンスRFCA処理によって電磁波の出力を開始するには、少なくともアクティブディレイタイム$T_{ADT}$ の間、電磁波が存在してはならない。
【００８６】
そして、初期遅延時間$T_{IDT}$ は、４０９６／$f_c$より大の値であるのに対して、アクティブディレイタイム$T_{ADT}$ は、７６８／$f_c$以上２５５９／$f_c$以下の値であることから、NFC通信装置がイニシエータになろうとする場合には、アクティブモードでの通信中において電磁波を出力しようとする場合よりも、電磁波が存在しない状態が長時間必要である。逆に言えば、NFC通信装置がアクティブモードでの通信中において電磁波を出力しようとする場合には、イニシエータになろうとする場合よりも、電磁波が存在しない状態になってから、それほど間をおかずに、電磁波を出力しなければならない。これは、次のような理由による。
【００８７】
即ち、NFC通信装置どうしがアクティブモードで通信を行う場合、一方のNFC通信装置は、自身で電磁波を出力してデータを送信し、その後、電磁波の出力を停止する。そして、他方のNFC通信装置が電磁波の出力を開始し、データを送信する。従って、アクティブモードの通信では、いずれのNFC通信装置も、電磁波の出力を停止していることがある。このため、NFC通信装置がイニシエータになろうとする場合には、そのNFC通信装置の周囲でアクティブモードの通信が行われていないことを確認するために、イニシエータになろうとしているNFC通信装置の周囲で、他の装置が電磁波を出力していないことを、十分な時間確認する必要がある。
【００８８】
これに対して、アクティブモードでは、上述したように、イニシエータが電磁波を出力することにより、ターゲットにデータを送信する。そして、ターゲットは、イニシエータが電磁波の出力を停止してから、電磁波の出力を開始することにより、イニシエータにデータを送信する。その後、イニシエータは、ターゲットが電磁波の出力を停止してから、電磁波の出力を開始することにより、イニシエータにデータを送信し、以下、同様にして、イニシエータとターゲットの間でデータがやりとりされる。
【００８９】
従って、アクティブモードの通信を行っているイニシエータとターゲットの周囲に、イニシエータとなろうとするNFC通信装置が存在する場合に、アクティブモードの通信を行っているイニシエータとターゲットのうちの一方が電磁波の出力を停止してから、他方が電磁波の出力を開始するまでの時間が長いと、その間は電磁波が存在しないため、イニシエータとなろうとするNFC通信装置が、初期RFCA処理によって電磁波の出力を開始する。この場合、先に行われていたアクティブモードの通信が妨げられることになる。

【００９０】
このため、アクティブモードの通信中に行われるレスポンスRFCA処理では、電磁波が存在しない状態になってから、それほど間をおかずに、電磁波を出力しなければならないようにしている。
【００９１】
次に、イニシエータになろうとするNFC通信装置は、図９で説明したように、初期RFCA処理によって電磁波の出力を開始し、その後、データの送信を行う。イニシエータになろうとするNFC通信装置は、電磁波の出力を開始することで、イニシエータとなり、そのイニシエータに近接する位置に存在するNFC通信装置はターゲットとなるが、イニシエータが、ターゲットとデータのやりとりをするには、そのデータをやりとりするターゲットを特定しなければならない。このため、イニシエータは、初期RFCA処理によって電磁波の出力を開始した後に、そのイニシエータに近接する位置に存在する１以上のターゲットに対して、各ターゲットを特定する情報としてのNFCIDを要求する。そして、イニシエータに近接する位置に存在するターゲットは、イニシエータからの要求に応じて、自身を特定するNFCIDを、イニシエータに送信する。
【００９２】
イニシエータは、以上のようにしてターゲットから送信されてくるNFCIDによってターゲットを特定し、その特定したターゲットとの間で、データのやりとりを行うが、イニシエータが、その周囲（近接する位置）に存在するターゲットを、そのNFCIDによって特定する処理は、SDD(Single Device Detection)処理と呼ばれる。
【００９３】
ここで、SDD処理において、イニシエータは、ターゲットのNFCIDを要求するが、この要求は、イニシエータが、ポーリングリクエストフレームと呼ばれるフレームを送信することによって行われる。ターゲットは、ポーリングリクエストフレームを受信すると、例えば、自身のNFCIDを乱数によって決定し、そのNFCIDを配置したポーリングレスポンスフレームと呼ばれるフレームを送信する。イニシエータは、ターゲットから送信されてくるポーリングレスポンスフレームを受信することで、ターゲットのNFCIDを認識する。
【００９４】
ところで、イニシエータが、その周囲のターゲットに対して、そのNFCIDを要求した場合、イニシエータの周囲に、複数のターゲットが存在するときには、その複数のターゲットの２以上から、同時に、NFCIDが送信されてくることがあり得る。この場合、その２以上のターゲットから送信されてくるNFCIDがコリジョンし、イニシエータは、そのコリジョンしたNFCIDを認識することができない。
【００９５】
そこで、SDD処理は、NFCIDのコリジョンをなるべく避けるために、例えば、タイムスロットを用いた方法で行われる。
【００９６】
即ち、図１１は、タイムスロットを用いた方法により行われるSDD処理のシーケンスを示している。なお、図１１では、イニシエータの周囲に、５つのターゲット＃１，＃２，＃３，＃４，＃５が存在するものとしてある。
【００９７】
SDD処理では、イニシエータがポーリングリクエストフレームを送信するが、その送信の完了後、所定の時間$T_d$だけおいて、所定の時間$T_s$の幅のタイムスロットが設けられる。なお、時間$T_d$は、例えば、５１２×６４／$f_c$とされ、タイムスロットの幅としての時間$T_s$は、例えば、２５６×６４／$f_c$とされる。また、タイムスロットは、例えば、時間的に最も先行するものから、０からのシーケンシャルな番号（整数）が付されることによって特定される。
【００９８】
ここで、図１１では、タイムスロット＃０，＃１，＃２，＃３の４つを示してあるが、タイムスロットは、例えば、１６などの所定の数まで設けることが可能である。あるポーリ

ングリクエストフレームに対して設けられるタイムスロットの数TSNは、イニシエータが指定し、ポーリングリクエストフレームに含められて、ターゲットに送信される。

【００９９】

ターゲットは、イニシエータから送信されてくるポーリングリクエストフレームを受信し、そのポーリングリクエストフレームに配置されているタイムスロットの数TSNを認識する。さらに、ターゲットは、０以上TSN－１の範囲の整数Ｒを、乱数により生成し、その整数Ｒによって特定されるタイムスロット＃Ｒのタイミングで、自身のNFCIDを配置したポーリングレスポンスフレームを送信する。

【０１００】

以上のように、ターゲットは、ポーリングレスポンスフレームを送信するタイミングとしてのタイムスロットを、乱数により決定するので、複数のターゲットがポーリングレスポンスフレームを送信するタイミングがばらつくこととなり、これにより、複数のターゲットが送信するポーリングレスポンスフレームどうしのコリジョンを極力避けることができる。

【０１０１】

なお、ターゲットにおいて、ポーリングレスポンスフレームを送信するタイミングとしてのタイムスロットを、乱数により決定しても、複数のターゲットがポーリングレスポンスフレームを送信するタイムスロットが一致し、これにより、ポーリングレスポンスフレームのコリジョンが生じる場合がある。図１１の実施の形態では、タイムスロット＃０において、ターゲット＃４のポーリングレスポンスフレームが、タイムスロット＃１において、ターゲット＃１と＃３のポーリングレスポンスフレームが、タイムスロット＃２において、ターゲット＃５のポーリングレスポンスフレームが、タイムスロット＃３において、ターゲット＃２のポーリングレスポンスフレームが、それぞれ送信されており、ターゲット＃１と＃３のポーリングレスポンスフレームがコリジョンを生じている。

【０１０２】

この場合、イニシエータは、コリジョンを生じているターゲット＃１と＃３のポーリングレスポンスフレームを正常に受信することができない。そのため、イニシエータは、再度、ポーリングリクエストフレームを送信し、これにより、ターゲット＃１と＃３に対して、それぞれのNFCIDが配置されたポーリングレスポンスフレームの送信を要求する。以下、イニシエータにおいて、その周囲にあるターゲット＃１乃至＃５すべてのNFCIDを認識することができるまで、イニシエータによるポーリングリクエストフレームの送信と、ターゲットによるポーリングレスポンスフレームの送信とが繰り返し行われる。

【０１０３】

なお、イニシエータが、ポーリングリクエストフレームを再度送信した場合に、すべてのターゲット＃１乃至＃５が、ポーリングレスポンスフレームを返すこととすると、再び、ポーリングレスポンスフレームどうしがコリジョンを起こす可能性が大である。そこで、ターゲットにおいては、イニシエータからポーリングリクエストフレームを受信した後、それほど時間をおかずに、ポーリングリクエストフレームを再度受信した場合には、例えば、そのポーリングリクエストを無視するようにすることができる。但し、この場合、図１１の実施の形態では、最初に送信されたポーリングリクエストフレームに対して、ポーリングレスポンスのコリジョンを生じているターゲット＃１と＃３については、イニシエータは、そのターゲット＃１と＃３のNFCIDを認識することができないので、ターゲット＃１または＃３との間でのデータのやりとりは、できないことになる。

【０１０４】

そこで、イニシエータが、ポーリングレスポンスフレームを正常に受信し、そのNFCIDを認識することができたターゲット＃２，＃４，＃５については、後述するように、通信対象から一時的にはずし、これにより、ポーリングリクエストフレームに対する応答としてのポーリングレスポンスフレームを返さないようにすることができる。この場合、イニシエータが送信する再度のポーリングリクエストフレームに対して、ポーリングレスポンスフレームを返してくるのは、最初のポーリングリクエストフレームの送信によってNFCID

を認識することができなかったターゲット＃１と＃３だけとなる。従って、この場合、ポーリングレスポンスフレームどうしがコリジョンを起こす可能性を小さくしながら、ターゲット＃１乃至＃５すべてのNFCIDを認識することが可能となる。

【０１０５】

また、ここでは、ターゲットは、上述したように、ポーリングリクエストフレームを受信すると、自身のNFCIDを、乱数によって決定（生成）する。このため、異なるターゲットから、同一のNFCIDがポーリングレスポンスフレームに配置されて、イニシエータに送信されてくる場合があり得る。イニシエータが、異なるタイムスロットにおいて、同一のNFCIDが配置されたポーリングレスポンスフレームを受信した場合、イニシエータには、例えば、ポーリングレスポンスフレームどうしがコリジョンを起こした場合と同様に、ポーリングリクエストフレームを再度送信させることができる。

【０１０６】

なお、上述の場合には、イニシエータが、ポーリングリクエストフレームを送信した直後のタイミングを基準として、タイムスロットを設け、そのタイムスロットのタイミングで、ターゲットが、ポーリングレスポンスフレームを送信するようにしたが、イニシエータとターゲットとの間でのポーリングリクエストフレームとポーリングレスポンスフレームのやりとりは、タイムスロットを用いずに行うことが可能である。即ち、ターゲットは、ポーリングリクエストフレームを受信した場合に、任意のタイミングで、ポーリングレスポンスフレームを送信するようにすることができる。但し、この場合、タイムスロットを用いる場合に比較して、イニシエータが送信するポーリングリクエストフレームに対し、複数のターゲットが同時期にポーリングレスポンスフレームを送信するケースが増大することが予想される。そして、複数のターゲットが同時期にポーリングレスポンスフレームを送信した場合には、イニシエータは、コリジョンによりポーリングレスポンスフレームを正常受信することができないため、ポーリングリクエストフレームを再送信する必要がある。

【０１０７】

ここで、上述したように、NFC通信装置は、既存のICカードシステムを構成するICカードやリーダ／ライタとの間でも、そのICカードやリーダ／ライタが採用している伝送レートで、データのやりとりを行うことができる。いま、ターゲットが、例えば、既存のICカードシステムのICカードである場合、SDD処理は、例えば、次のようにして行われる。

【０１０８】

即ち、イニシエータは、初期RFCA処理により、電磁波の出力を開始し、ターゲットであるICカードは、その電磁波から電源を得て、処理を開始する。つまり、いまの場合、ターゲットは、既存のICカードシステムのICカードであるから、動作するための電源を、イニシエータが出力する電磁波から生成する。

【０１０９】

ターゲットは、電源を得て、動作可能な状態になってから、例えば、最長でも２秒以内に、ポーリングリクエストフレームを受信する準備を行い、イニシエータからポーリングリクエストフレームが送信されてくるのを待つ。

【０１１０】

一方、イニシエータは、ターゲットにおいてポーリングリクエストフレームを受信する準備が整ったかどうかに関係なく、ポーリングリクエストフレームを送信することができる。

【０１１１】

ターゲットは、イニシエータからのポーリングリクエストフレームを受信した場合、上述したように、所定のタイムスロットのタイミングで、ポーリングレスポンスフレームを、イニシエータに送信する。イニシエータは、ターゲットからのポーリングレスポンスフレームを正常受信することができた場合、上述したように、そのターゲットのNFCIDを認識する。一方、イニシエータは、ターゲットからのポーリングレスポンスフレームを正常受信することができなかった場合、ポーリングリクエストフレームを、再度送信することが

できる。

【０１１２】

なお、いまの場合、ターゲットは、既存のICカードシステムのICカードであるから、動作するための電源を、イニシエータが出力する電磁波から生成する。このため、イニシエータは、初期RFCA処理によって開始した電磁波の出力を、ターゲットとの通信が完全に終了するまで続行する。

【０１１３】

次に、NFC通信装置では、イニシエータがターゲットにコマンドを送信し、ターゲットが、イニシエータからのコマンドに対するレスポンスを送信する（返す）ことで、通信が行われる。

【０１１４】

そこで、図１２は、イニシエータがターゲットに送信するコマンドと、ターゲットがイニシエータに送信するレスポンスとを示している。

【０１１５】

図１２において、アンダーバー(_)の後にREQの文字が記述されているものは、コマンドを表し、アンダーバー(_)の後にRESの文字が記述されているものは、レスポンスを表す。図１２の実施の形態では、コマンドとして、ATR_REQ，WUP_REQ，PSL_REQ，DEP_REQ，DSL_REQ，RLS_REQの６種類が用意されており、コマンドに対するレスポンスとしても、コマンドと同様に、ATR_RES，WUP_RES，PSL_RES，DEP_RES，DSL_RES，RLS_RESの６種類が用意されている。上述したように、イニシエータは、コマンド（リクエスト）をターゲットに送信し、ターゲットは、そのコマンドに対応するレスポンスをイニシエータに送信するので、コマンドは、イニシエータによって送信され、レスポンスは、ターゲットによって送信される。

【０１１６】

コマンドATR_REQは、イニシエータが、ターゲットに対して、自身の属性（仕様）を知らせるとともに、ターゲットの属性を要求するときに、ターゲットに送信される。ここで、イニシエータまたはターゲットの属性としては、そのイニシエータまたはターゲットが送受信することのできるデータの伝送レートなどがある。なお、コマンドATR_REQには、イニシエータの属性の他、そのイニシエータを特定するNFCIDなどが配置され、ターゲットは、コマンドATR_REQを受信することにより、イニシエータの属性とNFCIDを認識する。

【０１１７】

レスポンスATR_REQは、ターゲットが、コマンドATR_REQを受信した場合に、そのコマンドATR_REQに対する応答として、イニシエータに送信される。レスポンスATR_REQには、ターゲットの属性やNFCIDなどが配置される。

【０１１８】

なお、コマンドATR_REQやレスポンスATR_REQに配置される属性としての伝送レートの情報には、イニシエータやターゲットが送受信することのできるデータの伝送レートすべてを含めることができる。この場合、イニシエータとターゲットとの間で、コマンドATR_REQとレスポンスATR_REQのやりとりが１度行われるだけで、イニシエータは、ターゲットが送受信可能な伝送レートを認識することができ、ターゲットも、イニシエータが送受信可能な伝送レートを認識することができる。

【０１１９】

コマンドWUP_REQは、イニシエータが、通信するターゲットを選択するときに送信される。即ち、後述するコマンドDSL_REQを、イニシエータからターゲットに送信することにより、ターゲットを、ディセレクト(deselect)状態（イニシエータへのデータの送信（レスポンス）を禁止した状態）とすることができるが、コマンドWUP_REQは、そのディセレクト状態を解いて、ターゲットを、イニシエータへのデータの送信を可能にする状態とする場合に送信される。なお、コマンドWUP_REQには、ディセレクト状態を解くターゲットのNFCIDが配置され、コマンドWUP_REQを受信したターゲットのうち、そのコマンドWUP_REQに配置されているNFCIDによって特定されるターゲットが、ディセレクト状態を解く。

【０１２０】
レスポンスWUP_RESは、コマンドWUP_REQを受信したターゲットのうち、そのコマンドWUP_REQに配置されているNFCIDによって特定されるターゲットが、ディセレクト状態を解いた場合にコマンドWUP_REQに対する応答として送信される。
【０１２１】
コマンドPSL_REQは、イニシエータが、ターゲットとの通信に関する通信パラメータを変更するときに送信される。ここで、通信パラメータとしては、例えば、イニシエータとターゲットとの間でやりとりするデータの伝送レートなどがある。
【０１２２】
コマンドPSL_REQには、変更後の通信パラメータの値が配置され、イニシエータからターゲットに送信される。ターゲットは、コマンドPSL_REQを受信し、そこに配置されている通信パラメータの値にしたがって、通信パラメータを変更する。さらに、ターゲットは、コマンドPSL_REQに対するレスポンスPSL_RESを送信する。
【０１２３】
コマンドDEP_REQは、イニシエータが、データ（いわゆる実データ）の送受信（ターゲットとの間のデータ交換）を行うときに送信され、そこには、ターゲットに送信すべきデータが配置される。レスポンスDEP_RESは、ターゲットが、コマンドDEP_REQに対する応答として送信し、そこには、イニシエータに送信すべきデータが配置される。従って、コマンドDEP_REQによって、イニシエータからターゲットにデータが送信され、そのコマンドDEP_REQに対するレスポンスDEP_RESによって、ターゲットからイニシエータにデータが送信される。
【０１２４】
コマンドDSL_REQは、イニシエータが、ターゲットをディセレクト状態とするときに送信される。コマンドDSL_REQを受信したターゲットは、そのコマンドDSL_REQに対するレスポンスDSL_RESを送信してディセレクト状態となり、以後、コマンドWUP_REQ以外のコマンドには反応しなくなる（レスポンスを返さなくなる）。
【０１２５】
コマンドRLS_REQは、イニシエータが、ターゲットとの通信を完全に終了するときに送信される。コマンドRLS_REQを受信したターゲットは、そのコマンドRLS_REQに対するレスポンスRLS_RESを送信し、イニシエータとの通信を完全に終了する。
【０１２６】
ここで、コマンドDSL_REQとRLS_REQは、いずれも、ターゲットを、イニシエータとの通信の対象から解放する点で共通する。しかしながら、コマンドDSL_REQによって解放されたターゲットは、コマンドWUP_REQによって、再び、イニシエータと通信可能な状態となるが、コマンドRLS_REQによって解放されたターゲットは、イニシエータとの間で、上述したポーリングリクエストフレームとポーリングレスポンスフレームのやりとりが行われないと、イニシエータと通信可能な状態とならない。かかる点で、コマンドDSL_REQとRLS_REQは、異なる。
【０１２７】
なお、イニシエータは、あるターゲットにコマンドを送信する場合、例えば、ターゲットとの間でポーリングリクエストフレームとポーリングレスポンスフレームをやりとりすることにより認識した、そのターゲットのNFCIDを、コマンドに含めて送信する。一方、ターゲットは、コマンドを受信した場合、そのコマンドに含まれているNFCIDが、自身のNFCIDに一致するときに、そのコマンドに対するレスポンスをイニシエータに送信する。
【０１２８】
また、コマンドとレスポンスのやりとりは、例えば、トランスポート層で行うことができる。
【０１２９】
次に、図１３のフローチャートを参照して、NFC通信装置の通信処理について説明する。
【０１３０】

NFC通信装置は、通信を開始する場合、まず最初に、ステップＳ１において、他の装置による電磁波を検出したかどうかを判定する。

【０１３１】

ここで、NFC通信装置（図４）では、例えば、制御部２１が、検出部２３で検出される電磁波（NFC通信装置で用いられる電磁波と周波数帯域などが同様の電磁波）のレベルを監視しており、ステップＳ１では、そのレベルに基づき、他の装置による電磁波を検出したかどうかが判定される。

【０１３２】

ステップＳ１において、他の装置による電磁波が検出されなかったと判定された場合、ステップＳ２に進み、NFC通信装置は、その通信モードを、パッシブモードまたはアクティブモードに設定し、後述するパッシブモードのイニシエータの処理またはアクティブモードのイニシエータの処理を行う。そして、NFC通信装置は、その処理の終了後、ステップＳ１に戻り、以下、同様の処理を繰り返す。

【０１３３】

ここで、ステップＳ２においては、NFC通信装置の通信モードは、上述したように、パッシブモードまたはアクティブモードのうちのいずれに設定してもかまわない。但し、ターゲットが、既存のICカードシステムのICカードなどのパッシブモードのターゲットにしかなり得ない場合は、ステップＳ２では、NFC通信装置は、その通信モードを、パッシブモードに設定し、パッシブモードのイニシエータの処理を行う必要がある。

【０１３４】

一方、ステップＳ１において、他の装置による電磁波が検出されたと判定された場合、即ち、NFC通信装置の周辺で、他の装置による電磁波が検出された場合、ステップＳ３に進み、NFC通信装置は、ステップＳ１で検出された電磁波が検出され続けているかどうかを判定する。

【０１３５】

ステップＳ３において、電磁波が検出され続けていると判定された場合、ステップＳ４に進み、NFC通信装置は、その通信モードを、パッシブモードに設定し、後述するパッシブモードのターゲットの処理を行う。即ち、電磁波が検出され続けている場合というのは、例えば、NFC通信装置に近接する他の装置が、パッシブモードのイニシエータとなって、初期RFCA処理によって出力を開始した電磁波を出力し続けているケースであり、NFC通信装置は、パッシブモードのターゲットとなって処理を行う。そして、その処理の終了後は、ステップＳ１に戻り、以下、同様の処理が繰り返される。

【０１３６】

また、ステップＳ３において、電磁波が検出され続けていないと判定された場合、ステップＳ５に進み、NFC通信装置は、その通信モードを、アクティブモードに設定し、後述するアクティブモードのターゲットの処理を行う。即ち、電磁波が検出され続けていない場合というのは、例えば、NFC通信装置に近接する他の装置が、アクティブモードのイニシエータとなって、初期RFCA処理によって電磁波の出力を開始し、その後、その電磁波の出力を停止したケースであるから、NFC通信装置は、アクティブモードのターゲットとなって処理を行う。そして、その処理の終了後は、ステップＳ１に戻り、以下、同様の処理が繰り返される。

【０１３７】

次に、図１４のフローチャートを参照して、NFC通信装置によるパッシブモードのイニシエータの処理について説明する。

【０１３８】

パッシブモードのイニシエータの処理では、まず最初に、ステップＳ１１において、NFC通信装置は、電磁波の出力を開始する。なお、このパッシブモードのイニシエータの処理におけるステップＳ１１は、上述の図１３のステップＳ１において、電磁波が検出されなかった場合に行われる。即ち、NFC通信装置は、図１３のステップＳ１において、電磁波が検出されなかった場合に、ステップＳ１１において、電磁波の出力を開始する。従って

、ステップＳ１およびＳ１１の処理が、上述の初期RFCA処理に相当する。

【０１３９】

その後、ステップＳ１２に進み、NFC通信装置は、伝送レートを表す変数ｎを、初期値としての、例えば、１にセットし、ステップＳ１３に進む。ステップＳ１３では、NFC通信装置は、第ｎの伝送レート（以下、適宜、第ｎレートともいう）で、ポーリングリクエストフレームを送信し、ステップＳ１４に進む。ステップＳ１４では、NFC通信装置は、他の装置から、第ｎレートで、ポーリングレスポンスフレームが送信されてきたかどうかを判定する。

【０１４０】

ステップＳ１４において、他の装置から、ポーリングレスポンスフレームが送信されてきていないと判定された場合、即ち、例えば、NFC通信装置に近接する他の装置が、第ｎレートでの通信を行うことができず、第ｎレートで送信したポーリングリクエストフレームに対するポーリングレスポンスフレームが返ってこない場合、あるいは、周囲に他の装置が存在しない場合、ステップＳ１５乃至Ｓ１９をスキップして、ステップＳ２０に進む。

【０１４１】

また、ステップＳ１４において、他の装置から、第ｎレートで、ポーリングレスポンスフレームが送信されてきたと判定された場合、即ち、例えば、NFC通信装置に近接する他の装置が、第ｎレートでの通信を行うことができ、第ｎレートで送信したポーリングリクエストフレームに対するポーリングレスポンスフレームが返ってきた場合、ステップＳ１５に進み、NFC通信装置は、他の装置からのポーリングレスポンスフレームを正常受信することができたかどうかを判定する。ステップＳ１５において、他の装置からのポーリングレスポンスフレームを正常受信することができなかったと判定された場合、即ち、例えば、NFC通信装置の周囲に、複数の装置が存在し、その複数の装置からポーリングレスポンスフレームが、同一のタイムスロットで送信されてきたために、コリジョンが生じ、NFC通信装置が、ポーリングレスポンスフレームを正常受信することができなかった場合、ステップＳ１６乃至Ｓ１９をスキップして、ステップＳ２０に進む。

【０１４２】

また、ステップＳ１５において、他の装置からのポーリングレスポンスフレームを正常受信することができたと判定された場合、ステップＳ１６に進み、NFC通信装置は、そのポーリングレスポンスフレームを返してきた他の装置をパッシブモードのターゲットとして、そのターゲットのNFCIDを、ポーリングレスポンスフレームに配置されているNFCIDによって認識し、そのNFCIDが、後述するステップＳ１７で既に記憶したNFCIDと重複するかどうかを判定する。

【０１４３】

ステップＳ１６において、他の装置からのポーリングレスポンスフレームに配置されたNFCIDが、既に記憶しているNFCIDと重複すると判定された場合、ステップＳ１７乃至Ｓ１９をスキップして、ステップＳ２０に進む。

【０１４４】

また、ステップＳ１６において、他の装置からのポーリングレスポンスフレームに配置されたNFCIDが、既に記憶しているNFCIDと重複しないと判定された場合、ステップＳ１７に進み、NFC通信装置は、他の装置からのポーリングレスポンスフレームに配置されたNFCIDを、その、他の装置であるターゲットを特定するNFCIDとして記憶するとともに、そのターゲットが第ｎレートで通信可能であることを認識する。

【０１４５】

ここで、NFC通信装置は、ステップＳ１７において、パッシブモードのターゲットのNFCIDと、そのターゲットが第ｎレートで通信可能であることを認識すると、そのターゲットとの間の伝送レートを、第ｎレートに（一時的に）決定し、そのターゲットとは、コマンドPSL_REQによって伝送レートが変更されない限り、第ｎレートで通信を行う。

【０１４６】

また、NFC通信装置が、ステップＳ１７で記憶したターゲットのNFCIDは、例えば、そのタ

ーゲットとの通信が完全に終了したときに、NFC通信装置から消去される。

【０１４７】

その後、ステップＳ１８に進み、NFC通信装置は、ステップＳ１７で記憶したNFCIDのターゲット（パッシブモードのターゲット）に、コマンドDSL_REQを、第ｎレートで送信し、これにより、そのターゲットが、以後送信されるポーリングリクエストフレームに応答しないように、ディセレクト状態にして、ステップＳ１９に進む。

【０１４８】

ステップＳ１９では、NFC通信装置は、ステップＳ１８で送信したコマンドDSL_REQに対して、そのコマンドDSL_REQによりディセレクト状態とされるターゲットが返してくるレスポンスDSL_RESを受信し、ステップＳ２０に進む。

【０１４９】

ステップＳ２０では、NFC通信装置は、ステップＳ１３でポーリングリクエストフレームを、第ｎレートで送信してから、所定の時間が経過したかどうかを判定する。ここで、ステップＳ２０における所定の時間は、０以上の時間とすることができる。

【０１５０】

ステップＳ２０において、ステップＳ１３でポーリングリクエストフレームを、第ｎレートで送信してから、まだ、所定の時間が経過していないと判定された場合、ステップＳ１４に戻り、以下、ステップＳ１４乃至Ｓ２０の処理が繰り返される。

【０１５１】

ここで、ステップＳ１４乃至Ｓ２０の処理が繰り返されることにより、NFC通信装置は、図１１で説明したように、異なるタイムスロットのタイミングで送信されてくるポーリングレスポンスフレームを受信することができる。

【０１５２】

一方、ステップＳ２０において、ステップＳ１３でポーリングリクエストフレームを、第ｎレートで送信してから、所定の時間が経過したと判定された場合、ステップＳ２１に進み、NFC通信装置は、変数ｎが、その最大値であるＮに等しいかどうかを判定する。ステップＳ２１において、変数ｎが、最大値Ｎに等しくないと判定された場合、即ち、変数ｎが最大値Ｎ未満である場合、ステップＳ２２に進み、NFC通信装置は、変数ｎを１だけインクリメントして、ステップＳ１３に戻り、以下、ステップＳ１３乃至Ｓ２２の処理が繰り返される。

【０１５３】

ここで、ステップＳ１３乃至Ｓ２２の処理が繰り返されることにより、NFC通信装置は、Ｎ通りの伝送レートで、ポーリングリクエストフレームを送信するとともに、各伝送レートで返ってくるポーリングレスポンスフレームを受信する。

【０１５４】

一方、ステップＳ２１において、変数ｎが、最大値Ｎに等しいと判定された場合、即ち、NFC通信装置が、Ｎ通りのの伝送レートで、ポーリングリクエストフレームを送信するとともに、各伝送レートで返ってくるポーリングレスポンスフレームを受信した場合、ステップＳ２３に進み、NFC通信装置は、ポーリングレスポンスフレームが複数の装置から同時に送信されてきたこと等に起因して、正常受信することができなかったポーリングレスポンスフレームがあったかどうかと、ステップＳ１６で認識した他の装置のNFCIDの中に重複するものがあったかどうかを判定する。

【０１５５】

ステップＳ２３において、正常受信することができなかったポーリングレスポンスフレームがあったと判定されるか、またはステップＳ１６で認識した他の装置のNFCIDの中に重複するものがあったと判定された場合、ステップＳ１２に戻り、以下、同様の処理が繰り返される。これにより、イニシエータが正常受信することができなかったポーリングレスポンスフレームを送信してきた装置や、重複するNFCIDを送信してきた装置などの一意の識別が可能な、いわば正常なNFCIDを取得することができなかった装置に対しては、ポーリングリクエストフレームが再送信される。

【０１５６】
一方、ステップＳ２３において、正常受信することができなかったポーリングレスポンスフレームがないと判定され、かつステップＳ１６で認識した他の装置のNFCIDの中に重複するものがないと判定された場合、ステップＳ２４に進み、NFC通信装置は、パッシブモードのイニシエータとして、その通信処理（パッシブモードのイニシエータの通信処理）を行う。ここで、パッシブモードのイニシエータの通信処理については、後述する。
【０１５７】
そして、パッシブモードのイニシエータの通信処理が終了すると、NFC通信装置は、ステップＳ２４からＳ２５に進み、ステップＳ１１で出力を開始した電磁波の出力を停止し、処理を終了する。
【０１５８】
次に、図１５のフローチャートを参照して、NFC通信装置によるパッシブモードのターゲットの処理について説明する。
【０１５９】
パッシブモードのターゲットの処理では、まず最初に、ステップＳ３１において、NFC通信装置は、伝送レートを表す変数ｎを、初期値としての、例えば、１にセットし、ステップＳ３２に進む。ステップＳ３２では、NFC通信装置は、パッシブモードのイニシエータとなっている他の装置から、第ｎレートで、ポーリングリクエストフレームが送信されてきたかどうかを判定する。
【０１６０】
ステップＳ３２において、パッシブモードのイニシエータから、ポーリングリクエストフレームが送信されてきていないと判定された場合、即ち、例えば、NFC通信装置に近接する他の装置が、第ｎレートでの通信を行うことができず、第ｎレートでポーリングリクエストフレームを送信することができない場合、ステップＳ３３に進み、NFC通信装置は、変数ｎが、その最大値であるＮに等しいかどうかを判定する。ステップＳ３３において、変数ｎが、最大値Ｎに等しくないと判定された場合、即ち、変数ｎが最大値Ｎ未満である場合、ステップＳ３４に進み、NFC通信装置は、変数ｎを１だけインクリメントして、ステップＳ３２に戻り、以下、ステップＳ３２乃至Ｓ３４の処理が繰り返される。
【０１６１】
また、ステップＳ３３において、変数ｎが、最大値Ｎに等しいと判定された場合、ステップＳ３１に戻り、以下、ステップＳ３１乃至Ｓ３４の処理が繰り返される。即ち、ここでは、パッシブモードのイニシエータから、Ｎ通りの伝送レートのうちのいずれかで送信されてくるポーリングリクエストフレームを受信することができるまで、ステップＳ３１乃至Ｓ３４の処理が繰り返される。
【０１６２】
そして、ステップＳ３２において、パッシブモードのイニシエータから、ポーリングリクエストフレームが送信されてきたと判定された場合、即ち、NFC通信装置が、第ｎレートのポーリングリクエストフレームを正常受信した場合、ステップＳ３５に進み、NFC通信装置は、イニシエータの間の伝送レートを第ｎレートに決定するとともに、乱数によって、自身のNFCIDを生成し、ステップＳ３６に進む。ステップＳ３６では、NFC通信装置は、自身のNFCIDを配置したポーリングレスポンスフレームを、第ｎレートで送信し、ステップＳ３７に進む。
【０１６３】
ここで、NFC通信装置は、ステップＳ３６でポーリングレスポンスフレームを、第ｎレートで送信した後は、パッシブモードのイニシエータからコマンドPSL_REQが送信されてくることによって伝送レートの変更が指示されない限り、第ｎレートで通信を行う。
【０１６４】
ステップＳ３７では、NFC通信装置は、パッシブモードのイニシエータから、コマンドDSL_REQが送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ３１に戻り、以下、同様の処理を繰り返す。

【０１６５】
即ち、パッシブモードにおいて、ターゲットが、イニシエータから送信されてきたポーリングリクエストフレームに対して、ポーリングレスポンスフレームを送信した場合には、イニシエータは、図１４のステップＳ１８で説明したように、基本的には、そのターゲットに、コマンドDSL_REQを送信する。イニシエータが、ターゲットに対して、いわば例外的にコマンドDSL_REQを送信しないのは、図１４で説明したように、コリジョンによってポーリングレスポンスフレームを正常受信することができなかった場合か、またはポーリングレスポンスフレームを正常受信することができても、そのポーリングレスポンスフレームに配置されたNFCIDが、既にイニシエータが記憶しているターゲットのNFCIDと重複する場合である。即ち、イニシエータは、他のターゲットと識別することができるNFCID（正常なNFCID）を取得することができなかったターゲットに対しては、図１４のステップＳ１８において送信するコマンドDSL_REQを送信しない。

【０１６６】
従って、ステップＳ３７において、コマンドDSL_REQが送信されてきていないと判定された場合は、イニシエータが、ターゲットであるNFC通信装置の正常なNFCIDを取得することができなかった場合である。このため、パッシブモードのターゲットとなっているNFC通信装置では、ステップＳ３７からＳ３１に戻り、上述した場合と同様の処理、即ち、イニシエータから再送信されてくるポーリングリクエストフレームを受信し、新たなNFCIDを乱数により再生成してポーリングレスポンスフレームに含めて再送信することが繰り返される。

【０１６７】
一方、ステップＳ３７において、パッシブモードのイニシエータから、コマンドDSL_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドDSL_REQを受信した場合、ステップＳ３８に進み、NFC通信装置は、コマンドDSL_REQに対するレスポンスDSL_REQを送信し、ディセレクト状態となって、ステップＳ３９に進む。

【０１６８】
ステップＳ３９では、NFC通信装置は、パッシブモードのターゲットとして、その通信処理（パッシブモードのターゲットの通信処理）を行い、そのパッシブモードのターゲットの通信処理が終了すると、処理を終了する。なお、パッシブモードのターゲットの通信処理については、後述する。

【０１６９】
次に、図１６のフローチャートを参照して、NFC通信装置によるアクティブモードのイニシエータの処理について説明する。

【０１７０】
アクティブモードのイニシエータの処理では、ステップＳ５１乃至Ｓ６４において、図１４のパッシブモードのイニシエータの処理のステップＳ１１乃至Ｓ２４における場合とそれぞれ同様の処理が行われる。但し、図１４のパッシブモードのイニシエータの処理では、NFC通信装置は、その処理が終了するまで、電磁波を出力し続けるが、アクティブモードのイニシエータの処理では、NFC通信装置は、データを送信するときだけ、電磁波を出力する点が異なる。

【０１７１】
即ち、ステップＳ５１において、NFC通信装置は、電磁波の出力を開始する。
なお、このアクティブモードのイニシエータの処理におけるステップＳ５１は、上述の図１３のステップＳ１において、電磁波が検出されなかった場合に行われる。即ち、NFC通信装置は、図１３のステップＳ１において、電磁波が検出されなかった場合に、ステップＳ５１において、電磁波の出力を開始する。従って、ステップＳ１およびＳ５１の処理が、上述の初期RFCA処理に相当する。

【０１７２】
その後、ステップＳ５２に進み、NFC通信装置は、伝送レートを表す変数ｎを、初期値としての、例えば、１にセットし、ステップＳ５３に進む。ステップＳ５３では、NFC通信

装置は、第ｎレートで、ポーリングリクエストフレームを送信して、電磁波の出力を停止し（以下、適宜、RFオフ処理を行う、ともいう）、ステップＳ５４に進む。

【０１７３】

ここで、ステップＳ５３では、NFC通信装置は、ポーリングリクエストフレームを送信する前に、上述のアクティブRFCA処理によって電磁波の出力を開始する。但し、図１６のアクティブモードのイニシエータの処理において、ステップＳ５３の処理が最初に行われる場合は、図１３のステップＳ１および図１６のＳ５１の処理に対応する初期RFCA処理によって、既に電磁波の出力が開始されているので、アクティブRFCA処理を行う必要はない。

【０１７４】

ステップＳ５４では、NFC通信装置は、他の装置から、第ｎレートで、ポーリングレスポンスフレームが送信されてきたかどうかを判定する。

【０１７５】

ステップＳ５４において、他の装置から、ポーリングレスポンスフレームが送信されてきていないと判定された場合、即ち、例えば、NFC通信装置に近接する他の装置が、第ｎレートでの通信を行うことができず、あるいは、NFC通信装置の近くに、他の装置が存在しないために、第ｎレートで送信したポーリングリクエストフレームに対するポーリングレスポンスフレームが返ってこない場合、ステップＳ５５乃至Ｓ５９をスキップして、ステップＳ６０に進む。

【０１７６】

また、ステップＳ５４において、他の装置から、第ｎレートで、ポーリングレスポンスフレームが送信されてきたと判定された場合、即ち、例えば、NFC通信装置に近接する他の装置が、第ｎレートでの通信を行うことができ、第ｎレートで送信したポーリングリクエストフレームに対するポーリングレスポンスフレームが返ってきた場合、ステップＳ５５に進み、NFC通信装置は、他の装置からのポーリングレスポンスフレームを正常受信することができたかどうかを判定する。ステップＳ５５において、他の装置からのポーリングレスポンスフレームを正常受信することができなかったと判定された場合、即ち、例えば、NFC通信装置の周囲に、複数の装置が存在し、その複数の装置からポーリングレスポンスフレームが、同一のタイムスロットで送信されてきたために、コリジョンが生じ、NFC通信装置が、ポーリングレスポンスフレームを正常受信することができなかった場合、ステップＳ５６乃至Ｓ５９をスキップして、ステップＳ６０に進む。

【０１７７】

また、ステップＳ５５において、他の装置からのポーリングレスポンスフレームを正常受信することができたと判定された場合、ステップＳ５６に進み、NFC通信装置は、そのポーリングレスポンスフレームを返してきた他の装置をアクティブモードのターゲットとして、そのターゲットのNFCIDを、ポーリングレスポンスフレームに配置されているNFCIDによって認識し、そのNFCIDが、既に後述するステップＳ５７で既に記憶したNFCIDと重複するかどうかを判定する。

【０１７８】

ステップＳ５６において、他の装置からのポーリングレスポンスフレームに配置されたNFCIDが、既に記憶しているNFCIDと重複すると判定された場合、ステップＳ５７乃至Ｓ５９をスキップして、ステップＳ６０に進む。

【０１７９】

また、ステップＳ５６において、他の装置からのポーリングレスポンスフレームに配置されたNFCIDが、既に記憶しているNFCIDと重複しないと判定された場合、ステップＳ５７に進み、NFC通信装置は、他の装置からのポーリングレスポンスフレームに配置されたNFCIDを、その、他の装置であるターゲットを特定するNFCIDとして記憶するとともに、そのターゲットが第ｎレートで通信可能であることを認識する。

【０１８０】

ここで、NFC通信装置は、ステップＳ５７において、アクティブモードのターゲットのNFCIDと、そのターゲットが第ｎレートで通信可能であることを認識すると、そのターゲット

との間の伝送レートを、第ｎレートに決定し、そのターゲットとは、コマンドPSL_REQによって伝送レートが変更されない限り、第ｎレートで通信を行う。

【０１８１】

また、NFC通信装置が、ステップＳ５７で記憶したターゲットのNFCIDは、例えば、そのターゲットとの通信が完全に終了したときに、NFC通信装置から消去される。

【０１８２】

その後、ステップＳ５８に進み、NFC通信装置は、アクティブRFCA処理によって電磁波の出力を開始し、ステップＳ５５で記憶したNFCIDのターゲット（アクティブモードのターゲット）に、コマンドDSL_REQを、第ｎレートで送信する。

これにより、そのターゲットは、以後送信されるポーリングリクエストフレーム等に応答しないディセレクト状態となる。その後、NFC通信装置は、RFオフ処理を行い、ステップＳ５８からＳ５９に進む。

【０１８３】

ステップＳ５９では、NFC通信装置は、ステップＳ５８で送信したコマンドDSL_REQに対して、そのコマンドDSL_REQによりディセレクト状態とされるターゲットが返してくるレスポンスDSL_RESを受信し、ステップＳ６０に進む。

【０１８４】

ステップＳ６０では、NFC通信装置は、ステップＳ５３でポーリングリクエストフレームを、第ｎレートで送信してから、所定の時間が経過したかどうかを判定する。

【０１８５】

ステップＳ６０において、ステップＳ５３でポーリングリクエストフレームを、第ｎレートで送信してから、まだ、所定の時間が経過していないと判定された場合、ステップＳ５４に戻り、以下、ステップＳ５４乃至Ｓ６０の処理が繰り返される。

【０１８６】

一方、ステップＳ６０において、ステップＳ５３でポーリングリクエストフレームを、第ｎレートで送信してから、所定の時間が経過したと判定された場合、ステップＳ６１に進み、NFC通信装置は、変数ｎが、その最大値であるＮに等しいかどうかを判定する。ステップＳ６１において、変数ｎが、最大値Ｎに等しくないと判定された場合、即ち、変数ｎが最大値Ｎ未満である場合、ステップＳ６２に進み、NFC通信装置は、変数ｎを１だけインクリメントして、ステップＳ５３に戻り、以下、ステップＳ５３乃至Ｓ６２の処理が繰り返される。

【０１８７】

ここで、ステップＳ５３乃至Ｓ６２の処理が繰り返されることにより、NFC通信装置は、Ｎ通りの伝送レートで、ポーリングリクエストフレームを送信するとともに、各伝送レートで返ってくるポーリングレスポンスフレームを受信する。

【０１８８】

一方、ステップＳ６１において、変数ｎが、最大値Ｎに等しいと判定された場合、即ち、NFC通信装置が、Ｎ通りのＮ通りの伝送レートで、ポーリングリクエストフレームを送信するとともに、各伝送レートで返ってくるポーリングレスポンスフレームを受信した場合、ステップＳ６３に進み、NFC通信装置は、ポーリングレスポンスフレームが複数の装置から同時に送信されてきたこと等に起因して、正常受信することができなかったポーリングレスポンスフレームがあったかどうかと、ステップＳ５６で認識した他の装置のNFCIDの中に重複するものがあったかどうかを判定する。

【０１８９】

ステップＳ６３において、正常受信することができなかったポーリングレスポンスフレームがあったと判定されるか、またはステップＳ５６で認識した他の装置のNFCIDの中に重複するものがあったと判定された場合、ステップＳ５２に戻り、以下、同様の処理が繰り返される。これにより、イニシエータが正常受信することができなかったポーリングレスポンスフレームを送信してきた装置や、重複するNFCIDを送信してきた装置に対しては、ポーリングリクエストフレームが再送信される。

【０１９０】
一方、ステップＳ６３において、正常受信することができなかったポーリングレスポンスフレームがないと判定され、かつステップＳ５６で認識した他の装置のNFCIDの中に重複するものがないと判定された場合、ステップＳ６４に進み、NFC通信装置は、アクティブモードのイニシエータとして、その通信処理（アクティブモードのイニシエータの通信処理）を行い、その後、処理を終了する。ここで、アクティブモードのイニシエータの通信処理については、後述する。
【０１９１】
次に、図１７のフローチャートを参照して、NFC通信装置によるアクティブモードのターゲットの処理について説明する。
【０１９２】
アクティブモードのターゲットの処理では、ステップＳ７１乃至Ｓ７９において、図１５のパッシブモードのターゲットの処理のステップＳ３１乃至Ｓ３９における場合とそれぞれ同様の処理が行われる。但し、図１５のパッシブモードのターゲットの処理では、NFC通信装置は、パッシブモードのイニシエータが出力する電磁波を負荷変調することによってデータを送信するが、アクティブモードのターゲットの処理では、NFC通信装置は、自身で電磁波を出力してデータを送信する点が異なる。
【０１９３】
即ち、アクティブモードのターゲットの処理では、ステップＳ７１乃至Ｓ７５において、図１５のステップＳ３１乃至Ｓ３５における場合とそれぞれ同一の処理が行われる。
【０１９４】
そして、ステップＳ７５の処理後、ステップＳ７６に進み、NFC通信装置は、アクティブRFCA処理によって電磁波の出力を開始し、自身のNFCIDを配置したポーリングレスポンスフレームを、第ｎレートで送信する。さらに、ステップＳ７６では、NFC通信装置は、RFオフ処理を行い、ステップＳ７７に進む。
【０１９５】
ここで、NFC通信装置は、ステップＳ７６でポーリングレスポンスフレームを、第ｎレートで送信した後は、アクティブモードのイニシエータからコマンドPSL_REQが送信されてくることによって伝送レートの変更が指示されない限り、第ｎレートで通信を行う。
【０１９６】
ステップＳ７７では、NFC通信装置は、アクティブモードのイニシエータから、コマンドDSL_REQが送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ７１に戻り、以下、同様の処理を繰り返す。
【０１９７】
即ち、アクティブモードにおいて、ターゲットが、イニシエータから送信されてきたポーリングリクエストフレームに対して、ポーリングレスポンスフレームを送信した場合には、イニシエータは、図１６のステップＳ５８で説明したように、基本的には、そのターゲットに、コマンドDSL_REQを送信する。イニシエータが、ターゲットに対して、いわば例外的にコマンドDSL_REQを送信しないのは、図１６で説明したように、コリジョンによってポーリングレスポンスフレームを正常受信することができなかった場合か、またはポーリングレスポンスフレームを正常受信することができても、そのポーリングレスポンスフレームに配置されたNFCIDが、既にイニシエータが記憶しているターゲットのNFCIDと重複する場合である。即ち、イニシエータは、他のターゲットと識別することができるNFCID（正常なNFCID）を取得することができなかったターゲットに対しては、図１６のステップＳ５８において送信するコマンドDSL_REQを送信しない。
【０１９８】
従って、ステップＳ７７において、コマンドDSL_REQが送信されてきていないと判定された場合は、イニシエータが、ターゲットであるNFC通信装置の正常なNFCIDを取得することができなかった場合である。このため、アクティブモードのターゲットとなっているNFC通信装置では、ステップＳ７７からＳ７１に戻り、上述した場合と同様の処理、即ち、イ

ニシエータから再送信されてくるポーリングリクエストフレームを受信し、新たなNFCIDを乱数により再生成してポーリングレスポンスフレームに含めて再送信することが繰り返される。

【０１９９】

一方、ステップＳ７７において、パッシブモードのイニシエータから、コマンドDSL_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドDSL_REQを受信した場合、ステップＳ７８に進み、NFC通信装置は、アクティブRFCA処理によって電磁波の出力を開始し、コマンドDSL_REQに対するレスポンスDSL_REQを送信する。さらに、ステップＳ７８では、NFC通信装置は、RFオフ処理を行い、ディセレクト状態となって、ステップＳ７９に進む。

【０２００】

ステップＳ７９では、NFC通信装置は、アクティブモードのターゲットとして、その通信処理（アクティブモードのターゲットの通信処理）を行い、そのアクティブモードのターゲットの通信処理が終了すると、処理を終了する。なお、アクティブモードのターゲットの通信処理については、後述する。

【０２０１】

次に、図１８および図１９のフローチャートを参照して、図１４のステップＳ２４におけるパッシブモードのイニシエータの通信処理について説明する。

【０２０２】

パッシブモードのイニシエータであるNFC通信装置は、ステップＳ９１において、通信する装置（以下、適宜、注目装置という）を、図１４のステップＳ１５でNFCIDを記憶したターゲットの中から選択し、ステップＳ９２に進む。ステップＳ９２では、コマンドWUP_REQを、注目装置に送信し、これにより、図１４のステップＳ１９でコマンドDSL_REQを送信することによりディセレクト状態とした注目装置の、そのディセレクト状態を解除する（以下、適宜、ウエイクアップする、ともいう）。

【０２０３】

その後、NFC通信装置は、注目装置が、コマンドWUP_REQに対するレスポンスWUP_RESを送信してくるのを待って、ステップＳ９２からＳ９３に進み、そのレスポンスWUP_RESを受信して、ステップＳ９４に進む。ステップＳ９４では、NFC通信装置は、コマンドATR_REQを、注目装置に送信する。そして、NFC通信装置は、注目装置が、コマンドATR_REQに対するレスポンスATR_RESを送信してくるのを待って、ステップＳ９４からＳ９５に進み、そのレスポンスATR_RESを受信する。

【０２０４】

ここで、NFC通信装置および注目装置が、以上のようにして、属性が配置されるコマンドATR_REQとレスポンスATR_RESをやりとりすることで、NFC通信装置および注目装置は、互いに相手が通信可能な伝送レートなどを認識する。

【０２０５】

その後、ステップＳ９５からＳ９６に進み、NFC通信装置は、コマンドDSL_REQを、注目装置に送信し、注目装置を、ディセレクト状態にする。そして、NFC通信装置は、注目装置が、コマンドDSL_REQに対するレスポンスDSL_RESを送信してくるのを待って、ステップＳ９６からＳ９７に進み、そのレスポンスDSL_RESを受信して、ステップＳ９８に進む。

【０２０６】

ステップＳ９８では、NFC通信装置は、図１４のステップＳ１７でNFCIDを記憶したターゲットすべてを、ステップＳ９１で注目装置として選択したかどうかを判定する。ステップＳ９８において、NFC通信装置が、まだ、注目装置として選択していないターゲットがあると判定した場合、ステップＳ９１に戻り、NFC通信装置は、まだ、注目装置として選択していないターゲットのうちの１つを新たに注目装置として選択し、以下、同様の処理を繰り返す。

【０２０７】

また、ステップＳ９８において、NFC通信装置が、図１４のステップＳ１７でNFCIDを記憶

したターゲットすべてを、ステップＳ９１で注目装置として選択したと判定した場合、即ち、NFC通信装置が、NFCIDを記憶したターゲットすべてとの間で、コマンドATR_REQとレスポンスATR_RESをやりとりし、これにより、各ターゲットが通信可能な伝送レートなどを認識することができた場合、ステップＳ９９に進み、NFC通信装置は、通信する装置（注目装置）を、ステップＳ９４とＳ９５でコマンドATR_REQとレスポンスATR_RESをやりとりしたターゲットの中から選択し、ステップＳ１００に進む。

【０２０８】

ステップＳ１００では、NFC通信装置は、コマンドWUP_REQを、注目装置に送信し、これにより、ステップＳ９６でコマンドDSL_REQを送信することによってディセレクト状態とした注目装置をウエイクアップする。そして、NFC通信装置は、注目装置が、コマンドWUP_REQに対するレスポンスWUP_RESを送信してくるのを待って、ステップＳ１００からＳ１０１に進み、そのレスポンスWUP_RESを受信して、図１９のステップＳ１１１に進む。

【０２０９】

ステップＳ１１１では、NFC通信装置は、注目装置と通信を行う際の伝送レートなどの通信パラメータを変更するかどうかを判定する。

【０２１０】

ここで、NFC通信装置は、図１８のステップＳ９５でレスポンスATR_RESを、注目装置から受信しており、そのレスポンスATR_RESに配置された属性に基づき、注目装置が通信可能な伝送レート等の通信パラメータを認識している。NFC通信装置は、例えば、注目装置との間で、現在の伝送レートよりも高速の伝送レートで通信可能な場合、伝送レートをより高速な伝送レートに変更すべく、ステップＳ１１１において、通信パラメータを変更すると判定する。また、NFC通信装置は、例えば、注目装置との間で、現在の伝送レートよりも低速の伝送レートで通信可能であり、かつ、現在の通信環境がノイズレベルの高い環境である場合、伝送エラーを低下するために、伝送レートをより低速な伝送レートに変更すべく、ステップＳ１１１において、通信パラメータを変更すると判定する。なお、NFC通信装置と注目装置との間で、現在の伝送レートと異なる伝送レートで通信可能な場合であっても、現在の伝送レートのままで通信を続行することは可能である。

【０２１１】

ステップＳ１１１において、注目装置と通信を行う際の通信パラメータを変更しないと判定された場合、即ち、NFC通信装置と注目装置との間で、現在の伝送レートなどの現在の通信パラメータのままで、通信を続行する場合、ステップＳ１１２乃至Ｓ１１４をスキップして、ステップＳ１１５に進む。

【０２１２】

また、ステップＳ１１１において、注目装置と通信を行う際の通信パラメータを変更すると判定された場合、ステップＳ１１２に進み、NFC通信装置は、その変更後の通信パラメータの値を、コマンドPSL_REQに配置して、注目装置に送信する。そして、NFC通信装置は、注目装置が、コマンドPSL_REQに対するレスポンスPSL_RESを送信してくるのを待って、ステップＳ１１２からＳ１１３に進み、そのレスポンスPSL_RESを受信して、ステップＳ１１４に進む。

【０２１３】

ステップＳ１１４では、NFC通信装置は、注目装置との通信を行う際の伝送レートなどの通信パラメータを、ステップＳ１１２で送信したコマンドPSL_REQに配置した通信パラメータの値に変更する。NFC通信装置は、以後、注目装置との間で、再び、コマンドPSL_REQとレスポンスPSL_RESのやりとりをしない限り、ステップＳ１１４で変更された値の伝送レートなどの通信パラメータにしたがい、注目装置との通信を行う。

【０２１４】

なお、コマンドPSL_REQとレスポンスPSL_RESのやりとり（ネゴシエーション）によれば、伝送レート以外の、例えば、図４のエンコード部１６（デコード部１４）のエンコード方式や、変調部１９および負荷変調部２０（復調部１３）の変調方式などの変更も行うことが可能である。

【０２１５】
その後、ステップＳ１１５に進み、NFC通信装置は、注目装置との間で送受信すべきデータがあるかどうかを判定し、ないと判定された場合、ステップＳ１１６およびＳ１１７をスキップして、ステップＳ１１８に進む。
【０２１６】
また、ステップＳ１１５において、注目装置との間で送受信すべきデータがあると判定された場合、ステップＳ１１６に進み、NFC通信装置は、コマンドDEP_REQを注目装置に送信する。ここで、ステップＳ１１６では、NFC通信装置は、注目装置に送信すべきデータがある場合には、そのデータを、コマンドDEP_REQに配置して送信する。
【０２１７】
そして、NFC通信装置は、注目装置が、コマンドDEP_REQに対するレスポンスDEP_RESを送信してくるのを待って、ステップＳ１１６からＳ１１７に進み、そのレスポンスDEP_RESを受信して、ステップＳ１１８に進む。
【０２１８】
以上のように、NFC通信装置と注目装置との間で、コマンドDEP_REQとレスポンスDEP_RESがやりとりされることにより、いわゆる実データの送受信が行われる。
【０２１９】
ステップＳ１１８では、NFC通信装置は、通信相手を変更するかどうかを判定する。ステップＳ１１８において、通信相手を変更しないと判定された場合、即ち、例えば、まだ、注目装置との間でやりとりするデータがある場合、ステップＳ１１１に戻り、以下、同様の処理が繰り返される。
【０２２０】
また、ステップＳ１１８において、通信相手を変更すると判定された場合、即ち、例えば、注目装置との間でやりとりするデータはないが、他の通信相手とやりとりするデータがある場合、ステップＳ１１９に進み、NFC通信装置は、コマンドDSL_REQまたはRLS_REQを注目装置に送信する。そして、NFC通信装置は、注目装置が、コマンドDSL_REQまたはRLS_REQに対するレスポンスDSL_RESまたはRLS_RESを送信してくるのを待って、ステップＳ１１９からＳ１２０に進み、そのレスポンスDSL_RESまたはRLS_RESを受信する。
【０２２１】
ここで、上述したように、NFC通信装置が、注目装置に対して、コマンドDSL_REQまたはRLS_REQを送信することにより、その注目装置としてのターゲットは、イニシエータとしてのNFC通信装置との通信の対象から解放される。但し、コマンドDSL_REQによって解放されたターゲットは、コマンドWUP_UPによって、再び、イニシエータと通信可能な状態となるが、コマンドRLS_REQによって解放されたターゲットは、イニシエータとの間で、上述したポーリングリクエストフレームとポーリングレスポンスフレームのやりとりが行われないと、イニシエータと通信可能な状態とならない。
【０２２２】
なお、あるターゲットが、イニシエータとの通信の対象から解放されるケースとしては、上述のように、イニシエータからターゲットに対して、コマンドDSL_REQまたはRLS_REQが送信される場合の他、例えば、イニシエータとターゲットとが離れすぎて、近接通信を行うことができなくなった場合がある。この場合は、コマンドRLS_REQによって解放されたターゲットと同様に、ターゲットとイニシエータとの間で、ポーリングリクエストフレームとポーリングレスポンスフレームのやりとりが行われないと、イニシエータと通信可能な状態とならない。
【０２２３】
ここで、以下、適宜、ターゲットとイニシエータとの間で、ポーリングリクエストフレームとポーリングレスポンスフレームのやりとりが行われないと、イニシエータと通信可能にならないターゲットの解放を、完全解放という。また、イニシエータからコマンドWUP_UPが送信されることによって、再び、イニシエータと通信可能となるターゲットの解放を、一時解放という。

【０２２４】
ステップＳ１２０の処理後は、ステップＳ１２１に進み、NFC通信装置は、図１４のステップＳ１７でNFCIDを記憶したターゲットすべてが完全解放されたかどうかを判定する。ステップＳ１２１において、NFCIDを記憶したターゲットすべてが、まだ完全解放されていないと判定された場合、図１８のステップ９９に戻り、NFC通信装置は、完全解放されていないターゲット、即ち、一時解放されているターゲットの中から、新たに注目装置を選択し、以下、同様の処理を繰り返す。
【０２２５】
また、ステップＳ１２１において、NFCIDを記憶したターゲットすべてが完全解放されたと判定された場合、処理を終了する。
【０２２６】
なお、図１９のステップＳ１１６とＳ１１７において、コマンドDEP_REQとレスポンスDEP_RESがやりとりされることにより、ターゲットとイニシエータとの間で、データの送受信（データ交換）が行われるが、このコマンドDEL_REQとレスポンスDEP_RESのやりとりが、１つのトランザクションである。ステップＳ１１６とＳ１１７の処理後は、ステップＳ１１８，Ｓ１１１，Ｓ１１２，Ｓ１１３を介して、ステップＳ１１４に戻ることが可能であり、通信パラメータを変更することができる。従って、ターゲットとイニシエータとの間の通信に関する伝送レートなどの通信パラメータは、１つのトランザクションごとに変更することが可能である。
【０２２７】
また、ステップＳ１１２とＳ１１３において、イニシエータとターゲットの間で、コマンドPSL_REQとレスポンスPSL_RESをやりとりすることにより、ステップＳ１１４では、通信パラメータの１つであるイニシエータとターゲットの通信モードを変更することが可能である。従って、ターゲットとイニシエータの通信モードは、１つのトランザクションごとに変更することが可能である。なお、このことは、ターゲットとイニシエータの通信モードを、１つのトランザクションの間は、変更してはならないことを意味する。
【０２２８】
次に、図２０のフローチャートを参照して、図１５のステップＳ３９におけるパッシブモードのターゲットの通信処理について説明する。
【０２２９】
パッシブモードのターゲットであるNFC通信装置は、図１５のステップＳ３７およびＳ３８において、パッシブモードのイニシエータとの間で、コマンドDSL_REQとレスポンスDSL_RESのやりとりをしているので、ディセレクト状態となっている。
【０２３０】
そこで、ステップＳ１３１において、NFC通信装置は、イニシエータからコマンドWUP_REQが送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ１３１に戻り、ディセレクト状態のままとされる。
【０２３１】
また、ステップＳ１３１において、イニシエータからコマンドWUP_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドWUP_REQを受信した場合、ステップＳ１３１に進み、NFC通信装置は、コマンドWUP_REQに対するレスポンスWUP_RESを送信し、ウエイクアップして、ステップＳ１３３に進む。
【０２３２】
ステップＳ１３３では、NFC通信装置は、コマンドATR_REQが、イニシエータから送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ１３４をスキップして、ステップＳ１３５に進む。
【０２３３】
また、ステップＳ１３３において、イニシエータから、コマンドATR_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドATR_REQを受信した場合、ステップＳ１３５に進み、NFC通信装置は、コマンドATR_REQに対するレスポンスATR_RESを送信し、

ステップＳ１３５に進む。
【０２３４】
ステップＳ１３５では、NFC通信装置は、コマンドDSL_REQが、イニシエータから送信されてきたかどうかを判定する。ステップＳ１３５において、イニシエータから、コマンドDSL_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドDSL_REQを受信した場合、ステップＳ１３６に進み、NFC通信装置は、コマンドDSL_REQに対するレスポンスDSL_RESを送信し、ステップＳ１３１に戻る。これにより、NFC通信装置は、ディセレクト状態となる。
【０２３５】
一方、ステップＳ１３５において、イニシエータから、コマンドDSL_REQが送信されてきていないと判定された場合、ステップＳ１３７に進み、NFC通信装置は、コマンドPSL_REQが、イニシエータから送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ１３８およびＳ１３９をスキップして、ステップＳ１４０に進む。
【０２３６】
また、ステップＳ１３７において、イニシエータから、コマンドPSL_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドPSL_REQを受信した場合、ステップＳ１３８に進み、NFC通信装置は、コマンドPSL_REQに対するレスポンスPSL_RESを送信し、ステップＳ１３９に進む。ステップＳ１３９では、NFC通信装置は、イニシエータからのコマンドPSL_REQにしたがい、その通信パラメータを変更し、ステップＳ１４０に進む。
【０２３７】
ステップＳ１４０では、NFC通信装置は、イニシエータから、コマンドDEP_REQが送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ１４１をスキップして、ステップＳ１４２に進む。
【０２３８】
また、ステップＳ１４０において、イニシエータから、コマンドDEP_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドDEP_REQを受信した場合、ステップＳ１４１に進み、NFC通信装置は、コマンドDEP_REQに対するレスポンスDEP_RESを送信し、ステップＳ１４２に進む。
【０２３９】
ステップＳ１４２では、NFC通信装置は、イニシエータから、コマンドRSL_REQが送信されてきたかどうかを判定し、送信されてきていないと判定した場合、ステップＳ１３３に戻り、以下、同様の処理が繰り返される。
【０２４０】
また、ステップＳ１４２において、イニシエータから、コマンドRSL_REQが送信されてきたと判定された場合、即ち、NFC通信装置がコマンドRSL_REQを受信した場合、ステップＳ１４３に進み、NFC通信装置は、コマンドRSL_REQに対するレスポンスRSL_RESを送信し、これにより、イニシエータとの通信を完全に終了して、処理を終了する。
【０２４１】
次に、図２１および図２２は、図１６のステップＳ６４におけるアクティブモードのイニシエータの通信処理の詳細を示すフローチャートである。
【０２４２】
なお、図１８および図１９で説明したパッシブモードのイニシエータの通信処理では、イニシエータが電磁波を出力し続けているが、図２１および図２２のアクティブモードのイニシエータの通信処理では、イニシエータが、コマンドを送信する前に、アクティブRFCA処理を行うことによって電磁波の出力を開始し、コマンドの送信の終了後に、その電磁波の出力を停止する処理（オフ処理）を行う。かかる点を除けば、図２１のアクティブモードのイニシエータの通信処理では、ステップＳ１５１乃至Ｓ１６１と図２２のステップＳ１７１乃至Ｓ１８１において、図１８のステップステップＳ９１乃至Ｓ１０１と図１９のステップＳ１１１乃至Ｓ１２１における場合とそれぞれ同様の処理が行われるため、その説明は、省略する。

【０２４３】
次に、図２３は、図１７のステップＳ７９におけるアクティブモードのターゲットの通信処理の詳細を示すフローチャートである。
【０２４４】
なお、図２０で説明したパッシブモードのターゲットの通信処理では、ターゲットが、イニシエータが出力している電磁波を負荷変調することによってデータを送信するが、図２３のアクティブモードのターゲットの通信処理では、ターゲットが、コマンドを送信する前に、アクティブRFCA処理を行うことによって電磁波の出力を開始し、コマンドの送信の終了後に、その電磁波の出力を停止する処理（オフ処理）を行う。かかる点を除けば、図２３のアクティブモードのターゲットの通信処理では、ステップＳ１９１乃至Ｓ２０３において、図２０のステップＳ１３１乃至Ｓ１４３における場合とそれぞれ同様の処理が行われるため、その説明は、省略する。
【０２４５】
以上のように、イニシエータにおいては、ターゲットを識別するNFCIDを要求するポーリングリクエストフレームが送信され、そのポーリングリクエストフレームに対する応答としてターゲットが送信してくるポーリングレスポンスフレームに配置されたNFCIDが取得される。そして、イニシエータにおいて、ターゲットのNFCIDを正常に取得することができなかった場合は、ポーリングリクエストフレームが再送信される。一方、ターゲットは、イニシエータからのポーリングレスポンスフレームを受信すると、自身のNFCIDを乱数により生成し、ポーリングレスポンスフレームに配置して、イニシエータに送信する。さらに、ターゲットは、イニシエータからポーリングリクエストフレームを再受信した場合、自身のNFCIDを乱数により再生成し、ポーリングレスポンスフレームに配置して、イニシエータに再送信する。
【０２４６】
従って、イニシエータの周囲に複数のターゲットが近接している場合に、イニシエータは、その複数のターゲットそれぞれについて、ユニークなNFCIDを取得し、そのNFCIDによって複数のターゲットそれぞれを確実に識別することができる。その結果、イニシエータが、あるNFCID宛に送信したコマンドに対して、複数のターゲットから、同時にレスポンスが送信されてくることを防止することができる。
【０２４７】
また、NFCIDを乱数により生成するようにしたので、固定のユニークな番号等をNFCIDとした場合に必要となる、そのNFCIDを記憶しておくためのEEPROMを装置に設ける必要がなく、装置を低コストで製造等することが可能となる。
【０２４８】
なお、本明細書において、NFC通信装置が行う処理を説明する処理ステップは、必ずしもフローチャートとして記載された順序に沿って時系列に処理する必要はなく、並列的あるいは個別に実行される処理（例えば、並列処理あるいはオブジェクトによる処理）も含むものである。
【０２４９】
また、本実施の形態では、イニシエータが、近接する位置にあるすべてのターゲットのNFCIDを取得した後、あるターゲットを注目装置として通信を行う場合に、注目装置だけをディセレクト状態からウエイクアップし、他のターゲットをディセレクト状態にしたままにしておくようにしたが、近接する位置にあるすべてのターゲットのNFCIDを取得した後は、そのすべてのターゲットをウエイクアップして通信を行うようにすることが可能である。この場合、イニシエータが送信するコマンドが、いずれのターゲットに対するものであるかは、そのコマンドに配置されるNFCIDによって認識される。即ち、イニシエータが送信したコマンドは、そのコマンドに配置されたNFCIDのターゲットが受信し、そのコマンドに対するレスポンスを、ターゲットに返すことになる。
【０２５０】
さらに、本実施の形態では、本発明を、複数の伝送レートでのデータの送受信が可能なNF

C通信装置に適用した場合について説明したが、本発明は、その他、ある単一の伝送レートでのデータの送受信のみが可能な通信装置などにも適用可能である。さらに、本発明は、パッシブモードとアクティブモードのうちのいずれかのみによって通信を行う通信装置にも適用可能である。

【０２５１】

【発明の効果】

以上の如く、本発明によれば、２以上の通信相手から同時に応答が返ってくることを防止することができる。

【図面の簡単な説明】

【図１】本発明を適用した通信システムの一実施の形態の構成例を示す図である。

【図２】パッシブモードを説明する図である。

【図３】アクティブモードを説明する図である。

【図４】NFC通信装置１の構成例を示すブロック図である。

【図５】復調部１３の構成例を示すブロック図である。

【図６】変調部１９の構成例を示すブロック図である。

【図７】復調部１３の他の構成例を示すブロック図である。

【図８】復調部１３のさらに他の構成例を示すブロック図である。

【図９】初期RFCA処理を説明するタイミングチャートである。

【図１０】アクティブRFCA処理を説明するタイミングチャートである。

【図１１】SDD処理を説明する図である。

【図１２】コマンドとレスポンスの一覧を示す図である。

【図１３】NFC通信装置の処理を説明するフローチャートである。

【図１４】パッシブモードのイニシエータの処理を示すフローチャートである。

【図１５】パッシブモードのターゲットの処理を示すフローチャートである。

【図１６】アクティブモードのイニシエータの処理を示すフローチャートである。

【図１７】アクティブモードのターゲットの処理を示すフローチャートである。

【図１８】パッシブモードのイニシエータの通信処理を示すフローチャートである。

【図１９】パッシブモードのイニシエータの通信処理を示すフローチャートである。

【図２０】パッシブモードのターゲットの通信処理を示すフローチャートである。

【図２１】アクティブモードのイニシエータの通信処理を示すフローチャートである。

【図２２】アクティブモードのイニシエータの通信処理を示すフローチャートである。

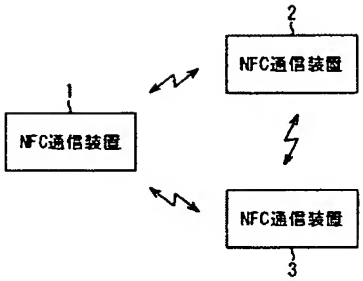
【図２３】アクティブモードのターゲットの通信処理を示すフローチャートである。

【符号の説明】

１乃至３　NFC通信装置，　１１　アンテナ，　１２　受信部，　１３　復調部，　１４　デコード部，　１５　データ処理部，　１６　エンコード部，　１７　選択部，　１８　電磁波出力部，　１９　変調部，　２０　負荷変調部，　２１　制御部，　２２　電源部，　２３　検出部，　２４　乱数発生部，　３１選択部，　$32_1$乃至$32_N$　復調部，　３３，４１　選択部，　$42_1$乃至$42_N$　変調部，　４３　選択部，　５１　可変レート復調部，　５２　レート検出部

【図１】

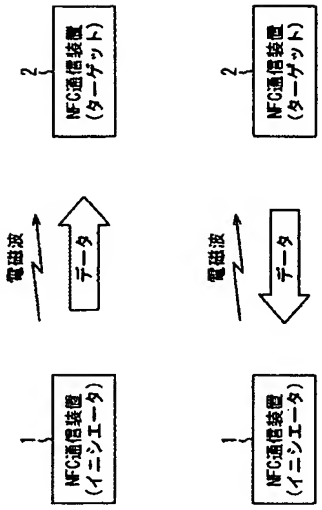
図1




通信システム

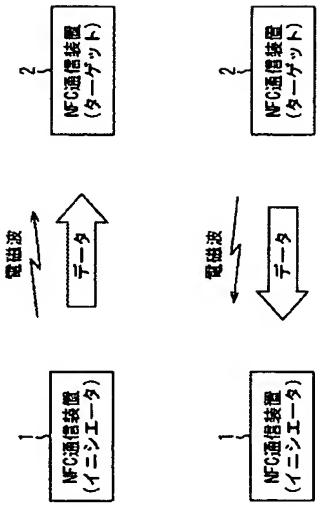
【図２】

図2



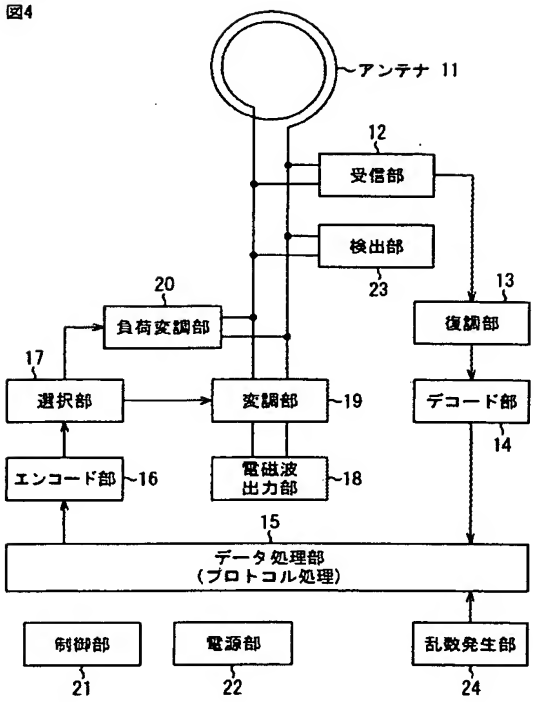

【図３】

図3



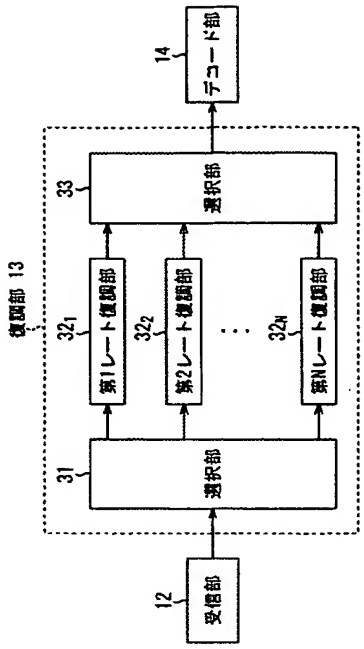

【図４】

図4



【図５】

図5




【図６】

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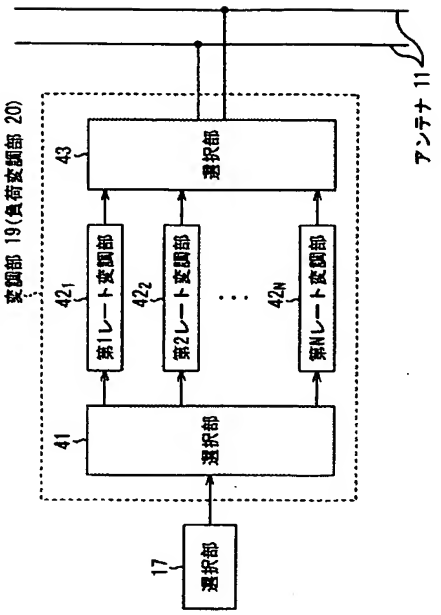


【図７】

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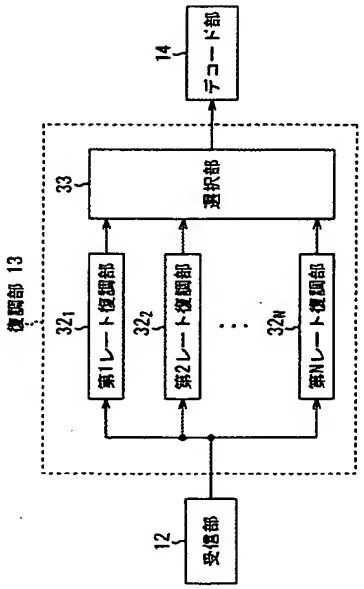
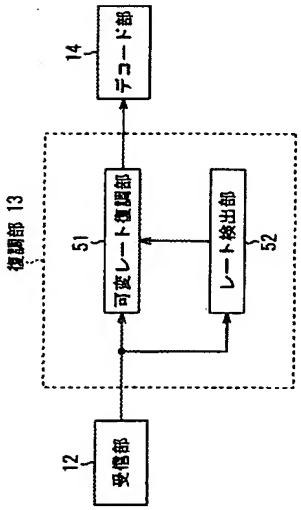


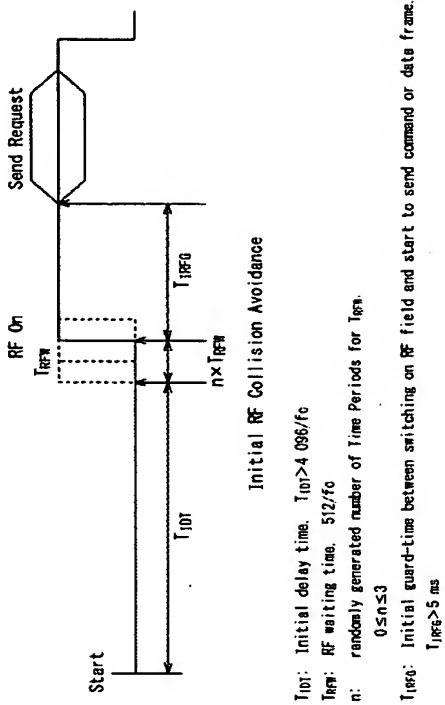

【図８】

図8



【図９】

図9




Initial RF Collision Avoidance

$T_{IDT}$: Initial delay time. $T_{IDT} > 4\,096/fc$

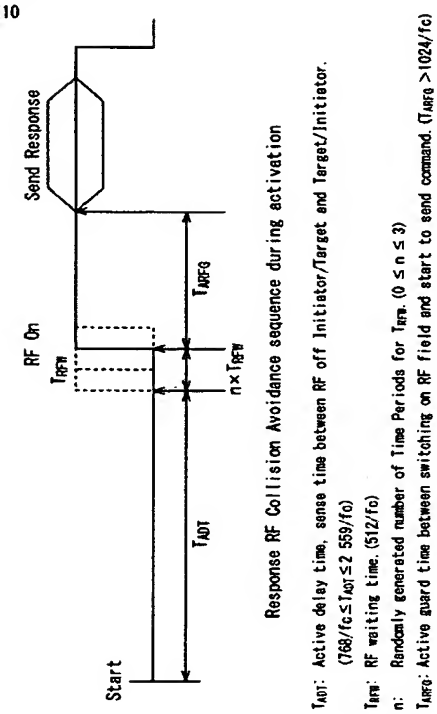
$T_{RFW}$: RF waiting time. $512/fc$

n: randomly generated number of Time Periods for $T_{RFW}$.
$0 \leq n \leq 3$

$T_{IRFG}$: Initial guard-time between switching on RF field and start to send command or data frame.
$T_{IRFG} > 5$ ms

【図１０】

図10




Response RF Collision Avoidance sequence during activation

$T_{ADT}$: Active delay time, sense time between RF off Initiator/Target and Target/Initiator.
$(768/fc \leq T_{ADT} \leq 2\,559/fc)$

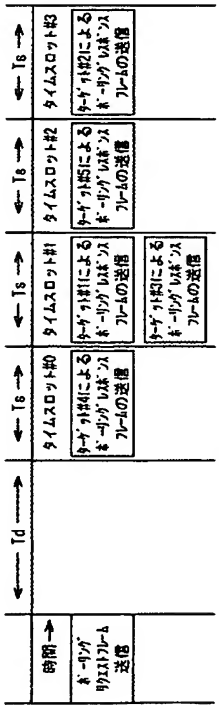
$T_{RFW}$: RF waiting time. $(512/fc)$

n: Randomly generated number of Time Periods for $T_{RFW}$. $(0 \leq n \leq 3)$

$T_{ARFG}$: Active guard time between switching on RF field and start to send command. $(T_{ARFG} > 1024/fc)$

【図１１】

図11




Single Device Detection by Time Slot

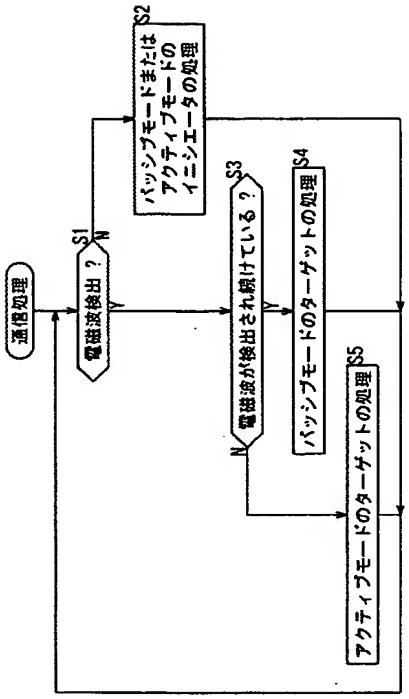
【図１２】

図12

| コマンド/レスポンス |
|---|
| ATR_REQ |
| ATR_RES |
| WUP_REQ |
| WUP_RES |
| PSL_REQ |
| PSL_RES |
| DEP_REQ |
| DEP_RES |
| DSL_REQ |
| DSL_RES |
| RLS_REQ |
| RLS_RES |

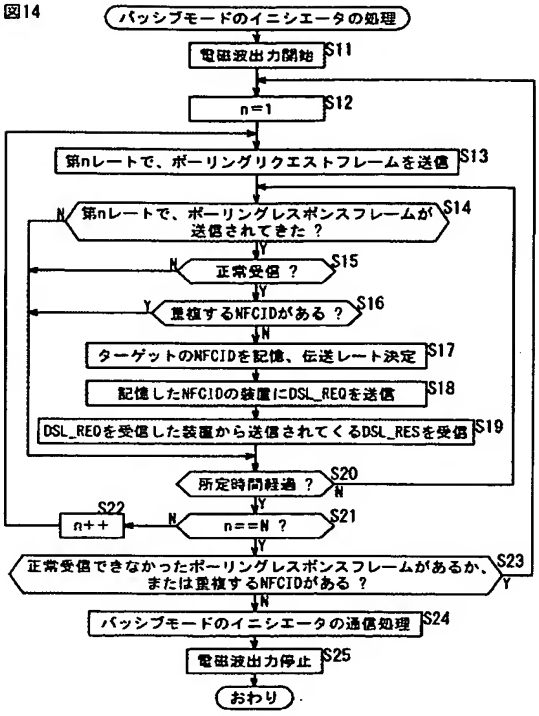
【図１３】

図13



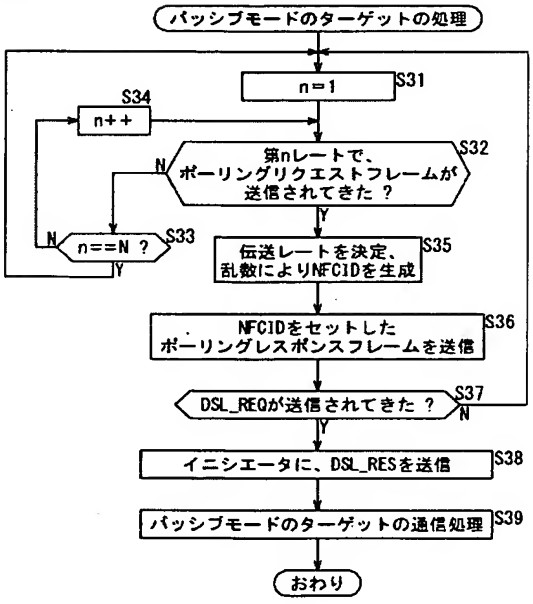

【図１４】

図14



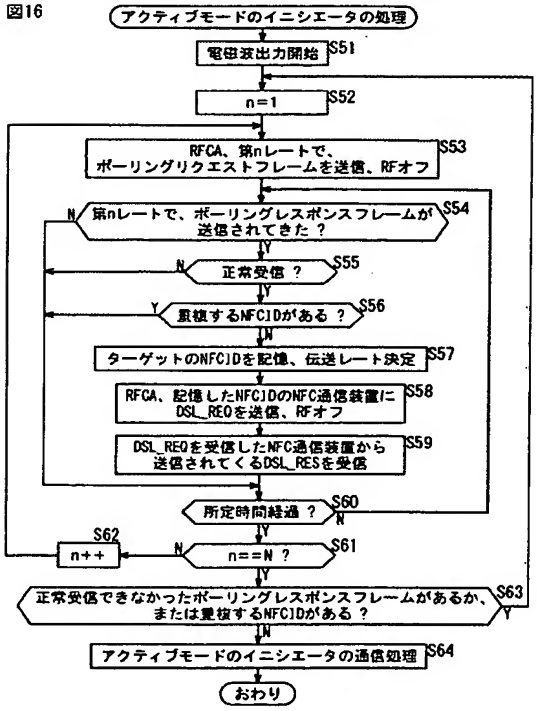

【図１５】

図15



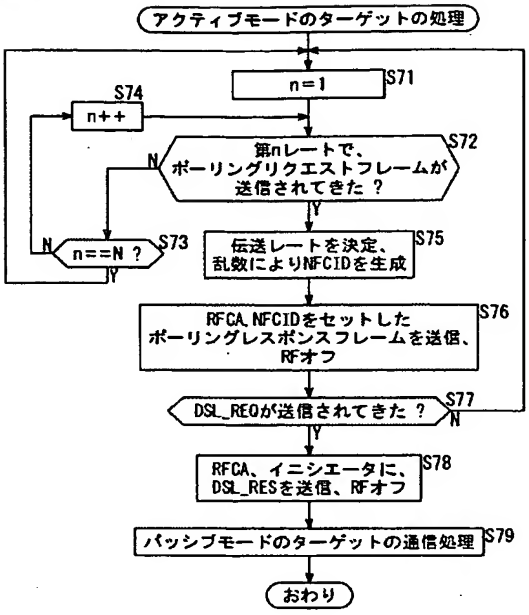

【図１６】

図16



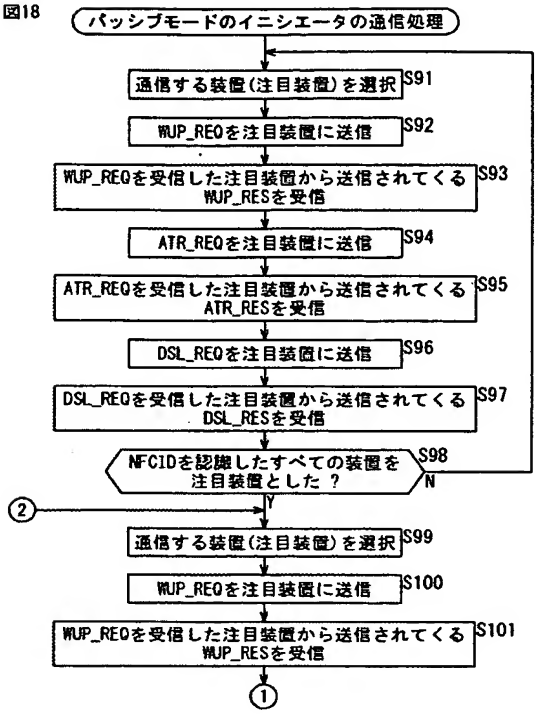
【図１７】

図17



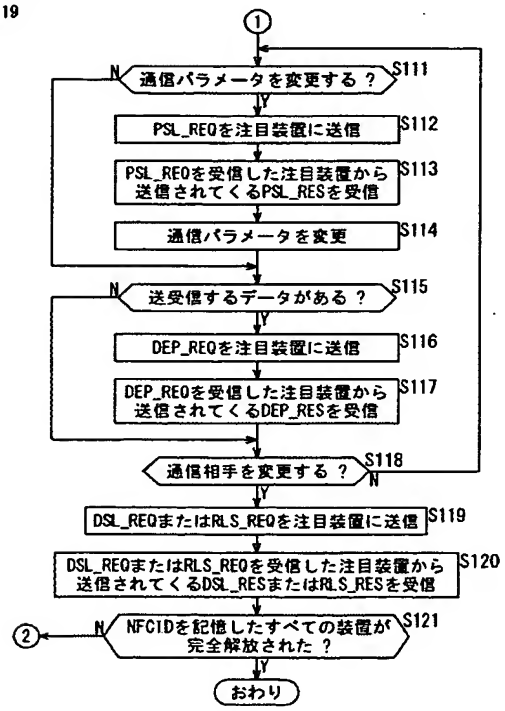

【図１８】

図18



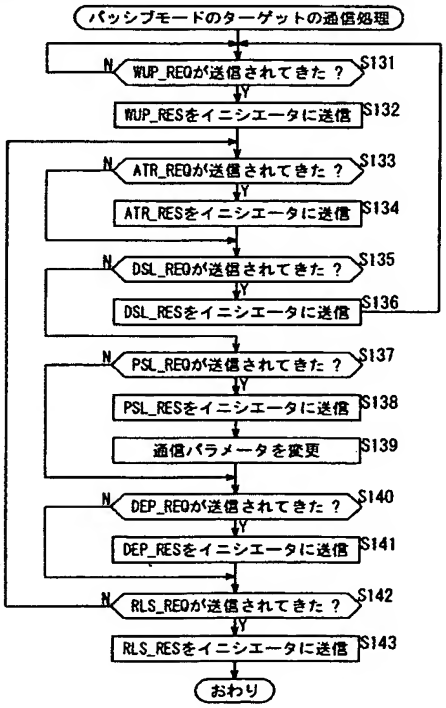

【図１９】

図19



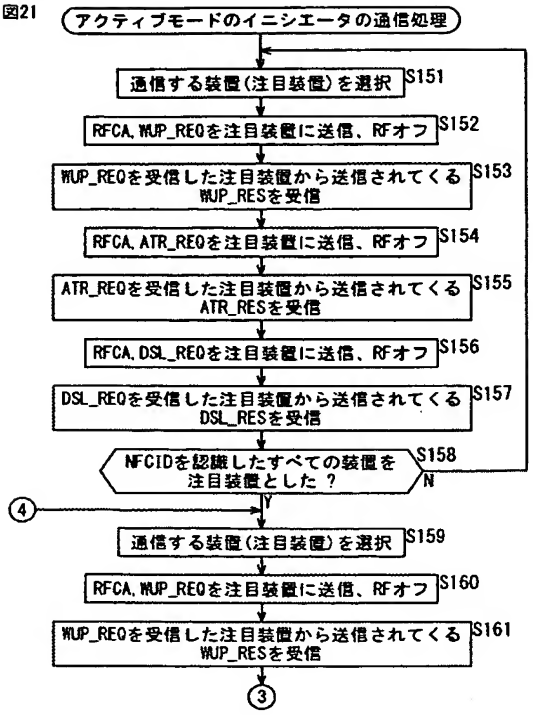

【図２０】

図20



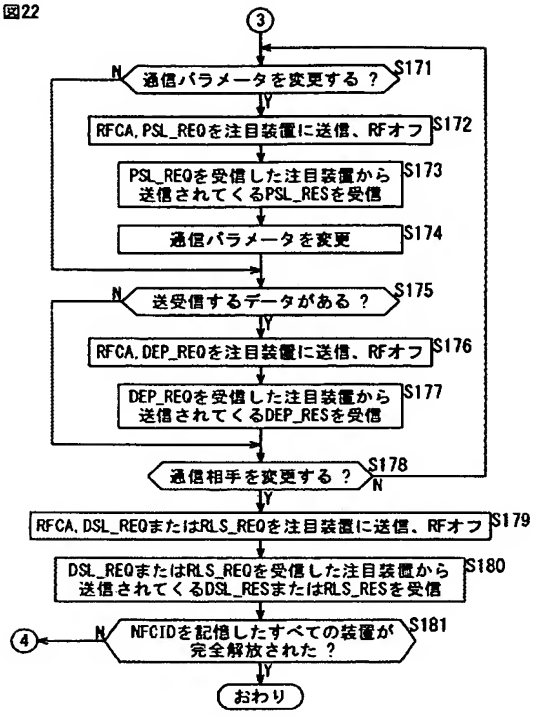
【図２１】

図21



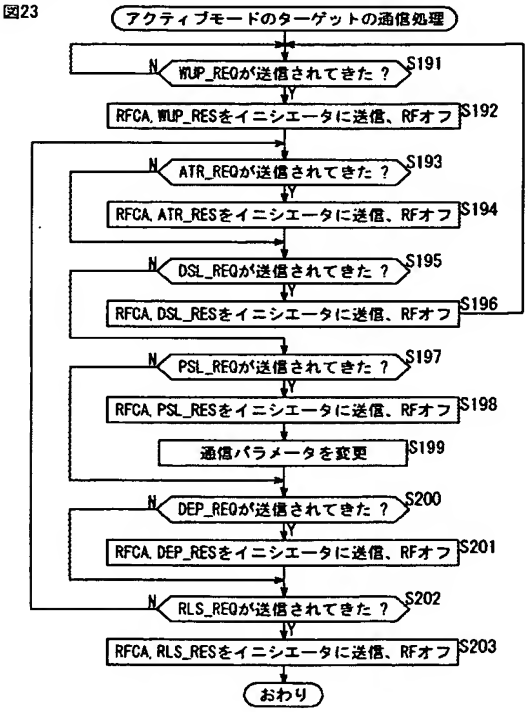

【図２２】

図22




【図２３】

図23



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